SCIENCE ABSTRACTS.

Section A.—PHYSICS.

SEPTEMBER, 1930.

GENERAL PHYSICS.

2990. Determination of Size of Powdered Particles (Glass). K. Kasai. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 242, *pp.* 135–183, *April* 30, 1930. *In German.*

Ordinary window glass was powdered in porcelain mortars, and the particles were graded by means of sieves and pneumatic classifiers. The coarse particles ranged in dimensions from 373 to $714\,\mu$, the fine particles from 14 to $56 \cdot 6\,\mu$. The surface area of the coarse particles was deduced from the rate of their dissolution in hydrofluoric acid, that of the fine particles from their adsorption of aqueous solution of caprylic acid and the capillary rise. The particles were counted. The area of their projections was determined microphotographically, and the accidental diameter (in the sense of G. Martin) was also determined. From these data the axes of the particles, supposed to be ellipsoids, were deduced and, further, the ratio of the real surface (with its irregularities) to the ideal. Lastly, the Stokes diameter was estimated, *i.e.*, the diameter corresponding to a sphere of the same size, density and same rate of fall in water. Although the particles were rough, their rate of sinking was more rapid than that of spherical particles, probably because they would glide down in a direction parallel to the large axes. H. B.

2991. Harmonic Analyser. J. Harvey. *Phys. Soc., Proc.* 42. *pp.* 245–249; *Disc.*, 249–250, *April* 15, 1930.

The paper describes a device for finding a given number of the Fourier components of a function by means of successive weighings. AUTHOR.

2992. Surface Tension of Solutions. Surface Tension, Surface Concentration and Activity. S. Palitzsch. *Zeits. f. phys. Chem.* 147. *Abt. A.* 1–2. *pp.* 51–68, *April*, 1930.

When the surface concentration w is calculated for the system urethane-sodium chloride-water by the formula of Gibbs, $u = -d\gamma/\mathrm{RT}\,.\,d\log a$ (where γ is the surface tension s.t. and a the activity of the solute), u is found not to approach a constant value (as it is supposed to do for films of fatty acids on water), but to rise quickly, fall off and finally to rise again very slowly. The curve u, as ordinate against concentration in mol., resembles that of Schofield and Rideal [see Abstract 2412 (1925)] for solutions of alcohol in water. If a relation between s.t. and surface concentration could be found, the activity could be calculated from Gibbs' formula. That is best done by the formula of Schofield and Rideal. But the terms and definitions in use are not clear. The s.t. as measured is not characteristic for the surface, nor does it correspond to a special surface energy. That assertion is not in contradiction to either Laplace or to Gibbs' original mathematical conception. Measurements are usually made on curved surfaces (not on the theoretical, plane-stretched membranes), and the quantity measured is the pressure normal to the surface (the cohesion pressure of Laplace), which is much larger than the tangential s.t., but not considered as it cancels out in the capillary effect. A substance which towers (raises) the s.t. is said to concentrate in the surface layer (to be drawn out of it). But the changes in molecular tension are not limited to the surface; they extend into the interior of the liquid. The normal surface pressure mentioned depends upon the adsorption and adhesion, being their natural consequence, not their cause. [See also 1271 (1930).] H. B.

2993. Jamin Effect in Cylindrical Tubes. W. O. Smith and M. D. Crane. *Am. Chem. Soc., J.* 52. *pp.* 1345–1349, *April,* 1930.

Jamin found that an ordinary cylindrical capillary tube filled with a chain of alternate air and water bubbles was capable of sustaining a finite pressure. Further investigation of the phenomenon by the authors showed that there were two Jamin effects, *viz.*, that occurring in cylindrical tubes and that in non-cylindrical capillaries. For the cylindrical case no effect was observed when the tubes were so clean that complete wetting occurred. When the tubes were contaminated by oleic acid in benzene finite pressures were observed. The results suggested that the Jamin effect arose in cylindrical tubes because of hysteresis of contact angles.

F. J. B.

2994. Structure of Capillary Layer in Liquids Consisting of Dipoles. H. F. Hertlein. *Ann. d. Physik,* 4. 7. *pp.* 898–922, *April* 15, 1930.

It is necessary to assume that the molecules in the surface layer are orientated more or less parallel to one another, and that in this way the negative potential energy of single molecules is considerably increased as compared with that calculated for irregularly arranged particles. It is estimated that if V_0 is the potential energy of a single molecule in the homogeneous liquid, the maximum increase for a molecule in the surface layer is in the neighbourhood of about $\frac{1}{2}V_0$. Shows that it is impossible that the density in the capillary layer should diminish linearly from the density of the liquid to that of the gas. There must be a relatively rapid increase on the side next to the liquid, and a very gradual fall on that next to the vapour. H. N. A.

2995. Draining of a Vertical Plate. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 26. *pp.* 204–205, *April,* 1930.

When a vessel of liquid has been emptied and put aside, a thin film of liquid clings to the inside and gradually drains down to the bottom under the influence of gravity. The layer being thin, the motion is nearly laminar flow, and taking the axis of x downwards, and that of z normal to the plate the equation of slow viscous motion is $\frac{du}{dt} = v\frac{\delta^2 u}{\delta z^2} + g$, where v is the kinematic viscosity. The author goes on to show that from mathematical considerations the profile of the surface near the top at any instant is a parabola, and that for ordinary vessels after they have been left to drain for a few seconds the correct solution is $h = (vx/gt)^{\frac{1}{2}}$. J. G. H. B.

2996. Phenomena of Contact of Solids. W. Stone. *Phil. Mag.* 9. *pp.* 610–620, *April,* 1930.

The objects of experiment were small glass beads 1–2 mm. in diameter, the method being to measure the adhesion by means of a direct observation of the deflection of one bead hung from a silk loop by a fine glass fibre, by drawing the second bead aside and reading the amount of movement by micrometer. The apparatus is fully described, and the author arrives at the following conclusions from the results obtained: (1) In the case of glass, adhesion is due to the presence of water molecules entangled in the surface layer of the glass. (When the experiment was conducted in artificially maintained dry air the adhesion disappeared.) (2) If water molecules once become entangled in the surface they are difficult to remove. (3) The phenomenon of adhesion may or may not be accompanied by electrical effects. In the case of German soft soda glass it is not; in the case of Jena glass, it is. (4) There is no adhesion between beads entirely immersed in water. (5) Surfaces of contact are not injured so long as the only forces acting are those of natural adhesion. J. G. H. B.

2997. Nature of Friction. P. E. Shaw. *Phil. Mag.* 9. *pp.* 628–639, *April,* 1930.

In another paper the author has shown that when two solid surfaces are separated electric separation takes place, even when the two materials are identical insulators or identical metals. It is assumed that solid combination takes place when contact occurs, and charging of both surfaces on separation. Work done in friction is the sum of that performed in electrical separation and that performed in deformation of the surface structure. Compares rolling and sliding friction on the assumption that both kinds are due to the breaking of solid bonds between the molecules which are in contact with one another. The simple law of friction is limited in application, and becomes invalid for extreme curvatures and for extreme loading. H. N. A.

2998. Static Friction and Adsorption. W. B. Hardy. *Kolloid Zeits.* 51. *pp.* 6–9, *April,* 1930.

This paper describes some experimental results bearing on the connection between the static friction of lubricated surfaces and adsorption. Certain paradoxes are discussed, *viz.,* the latent period, which is only observed with polar substances (*e.g.,* long chain acids or alcohols), and the relationship between adhesion and friction with the composition of a mixture of polar and non-polar substances. H. H. Ho.

2999. Method of Calculating Surfaces of Slip. B. Demtchenko. *Comptes Rendus,* 190. *pp.* 918–920, *April* 14, 1930.

Surfaces of slip in liquids may be studied either by the direct Helmholtz-Kirchhoff method, or by that of Levi-Civita or Villat. In the present paper the problem is generalised by means of a generalisation of the inversion of the Dirichlet problem. H. H. Ho.

3000. New Viscometer. A. Kämpf. *Kolloid Zeits.* 51. *pp.* 165–167, *April,* 1930.

A specially designed cylindrical rotor is mounted vertically in jewelled bearings and carries a pulley. A thread is wound round the latter and bears a weight, which moves in a vertical graduated tube as the system rotates. The rotor is immersed to a standard depth in the liquid in a cylindrical vessel, and can be released by a pneumatic device, which relieves one of its bearings of a constraining pressure. There is an immediate acceleration of the rotor, and the viscosity coefficient may be computed from the couple acting on the system and the mean velocity which it acquires in a measured time. [See following Abstract.] L. V. C.

3001. Calibration and Testing of Kämpf's New Viscometer. O. Schrenk. *Kolloid Zeits.* 51. *pp.* 167–171, *April,* 1930.

Calibration with castor oil and with solutions of cellulose derivatives shows that the initial acceleration of the rotor plays little part, and that the distance fallen by the driving weight is proportional to the time. For a standard fall of 100 cm. it is shown that the velocity acquired by the system is directly proportional to the total applied couple acting and inversely to the viscosity of the liquid; the relation is not strictly linear for the cellulose solutions, which, owing to their complex structure, give slightly anomalous results. A small correction is involved if smaller vessels than the standard (10 cm. diameter × 6 cm. deep) are employed. With this correction an accuracy of 0·5 % may be obtained in liquids with viscosities up to 3 c.g.s. units; a knowledge of the density of the liquid is unnecessary. [See preceding Abstract.] L. V. C.

3002. Rupture Phenomena in Streams of Viscous Liquids. M. Lagally. *Zeits. f. angew. Math. u. Mechanik,* 10. *pp.* 137–141, *April,* 1930.

The condition of stress existent in a stream of viscous liquid flowing in a cylindrical channel, in order that rupture of the fluid may result, is investigated mathematically along the lines first proposed by Somigliana. The analogous case of flow over an inclined plane is similarly examined, and it is shown that in this case rupture can occur only when the plane is inclined to the horizontal at an angle greater than 45°. J. S. G. T.

3003. Determination of Velocity as a Function of Turbulence for a Liquid of Two Dimensions. N. Théodoresco. *Comptes Rendus,* 190. *pp.* 916–918, *April* 14, 1930.

This mathematical problem is now solved by an entirely different method from that previously employed by the author in a corresponding problem of plane elasticity. [See Abstract 877 (1930).] H. H. Ho.

3004. Alternating Turbulence in Turbulent and Non-Turbulent Regions. P. Dupin and M. Teissié-Solier. *Comptes Rendus,* 190. *pp.* 920–922, *April* 14, 1930.

It has been shown previously that the law of dynamic similitude may be applied to periods of formation of alternating turbulence which arise in the wake of submerged cylinders. The same method has now been utilised for the study of the frequency of turbulence determined by given experimental conditions which are described in the paper. H. H. Ho.

3005. Equations of Motion of a Viscous Fluid in Tensor Notation. C. N. H. Lock. *Phys. Soc., Proc.* 42. *pp.* 264–287; *Disc.,* 287–288, *April* 15, 1930.

The tensor notation, which is probably best known in its application in Einstein's four-dimensional theory of gravitation, can be used in its three-dimensional form in obtaining the general equations in many branches of mathematical physics. In the present paper the various steps in the proof of the equations of motion of a viscous fluid are translated into tensor form. An attempt has been made to develop the various formulæ in outline from first principles, with references where necessary to a standard work, and also to give whenever possible a geometrical interpretation of the various vector quantities met with in the course of the argument. In particular the fundamental assumptions of Stokes, on which the viscous equations are based, are stated in the form of the relation between the stress vector across an element of area and the vector element of area. The equations of motion in tensor notation are afterwards translated into ordinary notation for the special case of orthogonal curvilinear coordinates. These can be at once reduced to the commonly useful forms of spherical polars, ellipsoidal coordinates, etc. In a final section it is shown how the tensor equations can be used to deduce the equations of viscous flow in terms of the Stokes stream function for motion symmetrical about an axis. The stream function is shown to be identical with the surviving component of the covariant vector potential of which the other two components vanish.

AUTHOR.

3006. Added Mass of Prisms Floating in Water. A. D. Browne, E. B. Moullin and A. J. Perkins. *Cambridge Phil. Soc., Proc.* 26. *pp.* 258–272, *April,* 1930.

A floating body performing free simple harmonic vibrations in a vertical plane creates a field of pulsating current flow in the liquid, and the total kinetic energy of the whole moving system corresponds to that of the floating body with an enhanced mass. The authors find the added mass of rectangular and triangular prisms floating in water, in connection with their investigation of the natural frequency of lateral vibration of a ship's hull. The experimental values are compared with those yielded by calculation. E. E. F. d'A.

3007. Dynamical Effect of a Translatory Current. E. Pistolesi. *Accad. Lincei, Atti,* 11. *pp.* 389–391, *Feb.* 16, 1930.

A rapid method is given for the solution of the problem previously considered by Raimondi [see Abstract 1279 (1930)], that of the calculation of the dynamical effect of a translatory current upon a cylinder in the neighbourhood of an indefinitely extended plane wall. The method of reflection is used. The indefinitely extended plane x is supposed to be removed, and its effect is replaced by the presence of a cylinder C′, the reflection of the given cylinder C in the plane x. J. J. S.

3008. Determination of Coefficient of Diffusion of Water Vapour. W. E. Summerhays. *Phys. Soc., Proc.* 42. *pp.* 218–225; *Disc.,* 225, *April* 15, 1930.

Water vapour was allowed to diffuse down a vertical tube about 2 in. in diameter, a steady concentration-gradient being maintained from approximate saturation at the top to approximate dryness at the bottom. The gradient was measured with two katharometers [see Abstract 1653 (1920)] at a definite distance apart, and the mass of vapour passing in an observed time was weighed. The result given is 0·282 cm.^{2}/sec. at mean temperature 16·1° C. AUTHOR.

3009. Problems in Elasticity. G. Supino. *Accad. Lincei, Atti,* 11. *pp.* 392–395, *Feb.* 16, 1930.

The problem previously dealt with by the author [see Abstract 1720 (1930)] is further considered in relation to the principle of fundamental solutions, and some examples are given. J. J. S.

3010. Theory of Collision of Spheres of Soft Metals. J. P. Andrews. *Phil. Mag.* 9. *pp.* 593–610, *April,* 1930.

Beginning with the fact that when two spheres of soft metal collide, permanent deformation is produced when the velocity of approach exceeds a definite critical value [see Abstract 1727 (1930)]; and with the aid of the assumption that over the permanently deformed region the pressure remains constant at all points, a theory of collision is worked out. This theory is found capable of accounting for the variation with the velocity of approach v, of (*a*) the duration of contact t of the spheres, (*b*) the diameters d of the permanent deformations, and (*c*) the coefficient of restitution e. The detailed character of the experimental results is explained. At high speeds of approach the duration of contact and the quantity e^2v^2 are linear functions of $\frac{1}{v}$ and of v respectively; while it appears that a definite quantity of energy is required per unit mass of the material apparently removed during deformation. A latent heat of deformation for a number of substances is calculated. Finally, the influence of viscous resistance and of time-effects, such as the elastic after-effect, etc., is considered.

AUTHOR.

3011. Cohesion Limits of Rock-Salt Crystals. F. Blank. *Zeits. f. Physik,* 61. 11–12. *pp.* 727–749, 1930.

The elastic limit (S) and breaking stress (Z) of twelve varieties of natural rock-salt crystals perpendicular to a cube face have been determined. The elastic limit is defined as reached when a glide plane—parallel to a rhombo-dodecahedral face—(or " translation-striation ") first appears (thus showing that rock-salt is not an ideal brittle crystal). Crystals of different origin show very different, though individually consistent results, S varying from 70 to 500 g./mm.^{2}, and Z from 217 to 1722; but S is always greater than Z, thus contradicting Joffé (*Zeits. f. Physik,* 22. 286, 1924). Tempered, *i.e.*, heated for 6 hrs. at varying temperatures, both S and Z steadily decline, practically the same (with one exception) minimum being attained after tempering at 600°; tempered at higher temperatures there is a steady rise in both quantities. More or less similar variations are found in crystals prepared artificially by fusion. It is inferred that these variations are, besides mechanical deformation, due to minute amounts of foreign substances, an explanation rendered probable by the fact that the most exceptional natural crystal (for which the minimum values at 600° are about 3 times the usual) appears to be specially impure, and that an artificial crystal containing 0·025 % lead chloride gave a very high value for Z (890 g./mm^2). Possible explanations are discussed, and full details of methods with numerous tables and curves given. C. A. S.

3012. Relation of Elastic Limit and Breaking Stress with Conditions of Crystallisation. A. Smekal. *Phys. Zeits.* 31. *pp.* 229–232, *March* 1, 1930.

A lecture summarising most of the results previously published by J. Gingold [see Abstract 277 (1929)] and by F. Blank [see preceding Abstract]. C. A. S.

3013. Dynamics of Boundary Layers in Rock-Salt Type Crystals. M. v. Laue. *Ann. d. Physik,* 4. 8. *pp.* 1121–1126, *April* 28, 1930.

From experiments by electron diffraction the net-plane distance d is found to be of the same order as deduced from X-ray data. This is strange, because for the latter some hundreds or thousands of planes are involved, whereas for the former twenty at most. The present note extends the earlier work of Madelung, and discusses the dynamics for displacements perpendicular to a (001) plane in rock-salt. These are $u_{+}^{(n)}$ and $u_{-}^{(n)}$ for a positive and negative ion, counting n from the outside. It is shown that from the potentials the lattice constant a can be calculated. The expression $(u_{+}^{(1)} - u_{-}^{(1)})/a$ is small of the first order, and $\frac{1}{2}(u_{+}^{(1)} + u_{-}^{(1)})/a$ is small of the second order. The displacements decrease rapidly with increasing n, which goes far to explain the result mentioned. F. I. G. R.

3014. Mosaic Structure of Crystals. F. Zwicky. *Helv. Phys. Acta*, 3. 3–4. *pp.* 269–316, 1930. *In German.*

The author extends and reviews previous work of his own [see Abstract 2671 (1929)] based mainly upon the conceptions of Smekal [see Abstract 3237 (1929)]. The solid state can show two characteristics, " structurally dependent " and "structurally independent." Examples of the former are density, specific heat, coefficient of expansion, total chemical energy content, compressibility, lattice structure. The latter comprise the elastic limit, ionic conductivity, etc.; it is not possible to draw a hard and fast line between these two categories. In order to reach the state of lowest energy for a crystal, it is necessary to postulate the existence of a secondary structure (mosaic structure) superposed upon the ordinary (X-ray) structure. This amounts in effect to a small periodic variation of density throughout the whole assemblage. The secondary structure is seen to be closely connected with the phenomenon of lateral contraction as well as with the deformability of the crystal units. Again, for crystals which contain atoms devoid of central symmetry, a secondary structure of the second kind may be anticipated. The temperature functions of the mosaic structure are also discussed. Finally, an attempt is made to link up these ideas with a wide range of physical facts under the name of the " Principle of Weak Asymmetry." Applications are given to the form of the water molecule, and to the well-known behaviour of monomolecular layers of organic substances on water surfaces. (See also Abstract 2728 (1930).] F. I. G. R.

3015. Polymorphism of Crystals and Orientation of Fatty Acids as a Function of Temperature. J. Thibaud and F. D. la Tour. *Comptes Rendus*, 190. *pp.* 945–947, *April*, 14, 1930.

For the polymorphic forms of the fatty acids [see Abstract 1282 (1927)] de Boer has determined for the acids with odd numbers of carbon atoms, the transition temperatures (below the melting points) at which passage from one crystalline form to another occurs. Similar transition temperatures exist with lauric, myristic, palmitic, stearic and cerotic acids, the two polymorphic crystalline modifications of which exhibit important differences in physical properties, especially in their refractive indices. T. H. P.

3016. Space-Group of Alkaline Sulphates. A. Ogg and A. E. H. Tutton. *Phil. Mag.* 9. *pp.* 665–667, *April*, 1930.

In consequence of the conclusion of Goeder [see Abstract 679 (1929)] that the space-group of certain of these sulphates (potassium, rubidium and cæsium) is V_h^{13}, additional arguments and calculations are adduced proving conclusively that this is incorrect, and that the space-group is V_h^{16}, as determined previously by Ogg [see Abstract 1156 (1928)], Taylor and Boyer [see Abstract 684 (1929)] and Tutton [see Abstract 489 (1930)]. The calculated and observed dimensions of the unit cell and the distances between the atomic centres of metal and oxygen and the sum of atomic radii agree within 0·2 %. C. A. S.

3017. Crystallisation of Potassium Alum and Effect of Impurities on its Habit. H. E. Buckley. *Zeits. f. Krist.* 73. 5–6. *pp.* 443–464, *April,* 1930. *In English.*

An investigation has been made of the influence on the habit of potassium alum of (I) varying physical conditions: (*a*) evaporation at the ordinary temperature, (*b*) slow and (*c*) rapid cooling to the ordinary temperature, (*d*) slow and (*e*) rapid evaporation at higher temperatures, and (II) of the addition of twenty-seven different substances. (I) When growth is slow (*a, b, d*) the rates of growth of the three principal forms {111}, {100} and {110}, are such as to allow of the development of quite large {100} and {110} planes, though {111} is always predominant; by (*d*) {110} tends to predominate over {100}. With rapid growth (*c, e*) {111} becomes more and more predominant. (II) Though in some cases so far indeterminate, the chief conclusions are: {100} predominates in presence of alkaline substances; {110} in that of potassium chlorate, urea, glucose, and glycerol, whilst aluminium and ferric chlorides, the mineral acids, oxalic acid and sodium chlorate have generally a contrary effect; hydrochloric acid encourages the growth of {210}, aluminium and ferric chlorides, and amyl alcohol that of {211}, and to some extent of {221}; oscillatory or repeated parallel growths are caused by Bismarck brown and safranine. The results of Shubnikow and Spangenburg are discussed. C. A. S.

3018. Typical Triangular Vicinal Pyramids on Triangular Faces. G. Kalb. *Zeits. f. Krist.* 73. 5–6. *pp.* 561–566, *April,* 1930.

On the assumptions previously made (see *Zeits. f. Krist.* 73. 2. *p.* 266, 1930) the five different combinations of triangular vicinal pyramids with triangular crystal faces are described, figured and exemplified from natural crystals. Six-sided pyramids are also possible on such faces on crystals of classes C_{3v}, D_{3d}, D_{3h}, T_d and O_h, but only three-sided on those of classes C_3, C_{3i}, D_3, C_{3h}, T, O and T_h. With natrolite as an example a method of deducing approximately correct axial ratios from measurements on faces covered with vicinal faces is given. C. A. S.

3019. Masses of the Proton and Electron. H. T. Flint. *Phys. Soc., Proc.* 42. *pp.* 239–242; *Disc.,* 242–244, *April* 15, 1930.

An application of a principle proposed by the author and described as the principle of minimum proper time is made to obtain an equation for the ratio of the masses of the proton and electron. The result obtained is in agreement with the experimental value. The possibility of explaining the asymmetry in regard to the masses by means of a metrical consideration is discussed. [See also Abstract 1183 (1928).] AUTHOR.

3020. Atomic Nuclei and their Structure. E. Rutherford. *Engineering,* 129. *pp.* 371–372, *March* 21; 397–398, *March* 28; 437–438, *April* 4, *and pp.* 470–471, *April* 11, 1930.

Four lectures, delivered at the Royal Institution, giving the history of the important steps in nuclear research, commencing with the suggestion, based on the deflection of α-rays, that the positive charge of the atom is concentrated into a minute nucleus, which was made by the lecturer in

1911. Among the recent results dealt with was the discovery in the solar spectrum of a very faint, but distinct, system of bands by Johnson and Gaique, which they attributed to an oxygen isotope with atomic weight 18; a much feebler system of bands has also been observed attributable to an oxygen isotope with atomic weight 17. The proportion of these isotopes in oxygen is very minute, and does not make a measurable difference to the atomic weight of oxygen. Mott's results on the scattering of α particles derived by calculation by means of wave mechanics were noticed. The new theory of the nucleus based on wave mechanics considers that the α-particles are shut up in a spherical shell surrounded by a potential barrier, with a possibility of a leakage of the wave system corresponding to each α-particle through the barrier, which would account for radioactivity. The energy relations connected with the packing fractions of the elements were dealt with, and it was shown that the additional free electrons, introduced from time to time into the nucleus as α-particles are added to obtain elements with higher atomic numbers, are required to preserve stability. H. N. A.

3021. Atomic Dimensions. B. B. Ray and B. C. Mukherjee. *Indian Journ. Phys.* 4. *pp.* 467–476, *April* 30, 1930.

The object of the authors is to explain the conductivity of metals and the non-conductivity of non-metals. Makes use of the work of Lennard-Jones, who, using wave mechanics, has drawn the equipotential surface in a metal crystal which is due to the fact that the atoms are drawn together, so that their outer electrons intermingle, can travel freely without doing any work, and in this restricted sense can be called free. In non-metals, such as the alkaline halides, the authors show that the distance between the scattering centres is greater than the sum of the atomic or ionic radii, the result being that the valency electrons do not intermingle, but are attached to the atoms to which they belong, no such equipotential surface is formed, and the substance is a non-conductor. The authors calculate atomic and ionic radii by the methods of Bragg and Saha. H. N. A.

3022. Origin of the Chemical Elements. S. B. Stone. *J. Phys. Chem.* 34. *pp.* 821–841, *April,* 1930.

Aston's new method of obtaining atomic weights gives values which, when used in calculations based on the theory of relativity, show that the calculated mass decrease in radioactive transformations can account for the energy changes. Atomic weights of the elements are approximately integers on the oxygen basis, and this condition is shown to be restated in an equation which connects mass defect and atomic weight. From the assumption that atomic formation occurs through the union of helium and hydrogen nuclei, it is concluded that an upper limit of 340 for the atomic weight is to be expected, and matter is concentrated into the lighter elements and into the 4K type of atom. Also an explanation is obtained accounting for the evolution of the radioactive elements which agrees with thermodynamic principles, and gives the possibility of slight variation in any one type of atom. An explanation of the cosmic rays, which is fundamentally identical with that due to Millikan and Cameron, is developed in terms of a kinetic hypothesis. The differences are that the present author's explanation requires the presence of a large amount of soft radiation in the helium band, no iron band being required. Finally, a magnetic hypothesis of the mechanism of atomic creation is proposed which explains the origin of cosmic rays in interstellar space, the concentration of the lighter elements into the 4K type, the reason for the divergence of the heavier atoms from Harkin's rules and the known facts concerning the distribution of isotopes and isobars. R. C. F.

3023. Classification of the Isotopes. Part III. G. Beck. *Zeits. f. Physik*, 61. 9–10. *pp.* 615–618, 1930.

Attempts to describe somewhat more accurately the relation of the nuclear electrons in the building up of the system of isotopes, on the basis of the Pauli principle and of the spin of the electrons. The result is that the multiplicity of the electron terms in the nucleus is correctly described by Dirac spherical functions. Considers the possibility of experimental verification of the theory. [See also Abstract 3170 (1928).] H. N. A.

3024. Cybotactic (Molecular Group) Condition in Liquids; Nature of Association of Octyl Alcohol Molecules. G. W. Stewart. *Phys. Rev.* 35. *pp.* 726–732, *April* 1, 1930.

Twelve experimental lines of evidence are cited in favour of the adoption of the molecular group theory of the nature of liquids. This theory is assumed in the interpretation of results with octyl alcohols. Twenty-two octyl alcohols were used. The value of the effective diameter of the primary normal alcohols is approximately 4·5 Å. With these octyl alcohols the increase for OH and CH_3 in a branch is approximately 0·0 Å. and 0·24 to 0·75 Å. respectively. When attached to the same carbon atom the increase caused thereby is not noticeable. These results are in fair agreement with previous similar measurements of isomers with other primary alcohols. Two types of associations were found. When the OH group is attached to the end or next to the end of the alcohol molecule, two of these molecules are associated end to end, the lengths of the chains being in the same straight line. On the other hand, when the OH group is attached to any other carbon atom, the molecules are associated side by side. This is shown by the planar distances in the direction of the molecule which indicate in the first case the length of two molecules and in the second case the length of a single molecule. AUTHOR.

3025. Parachor and Molecular Volume. A. Ferguson. *Nature*, 105. *pp.* 597–598, *April* 19, 1930.

The author discusses adversely the assumption that a parachor is in fact a molecular volume which is independent of the temperatures at which it is measured, and therefore replaces, with greatly enhanced efficiency, the old molecular volumes. He concludes that it is preferable to treat the parachor as a parachor, and to discuss the problem of molecular volumes on an entirely independent basis. H. H. Ho.

3026. Calculation of Molecular Weight of Liquids from the Coefficients of Stress. R. O. Herzog. *Zeits. f. phys. Chem.* 147. *Abt. A.* 1–2. *pp.* 118–124, *April*, 1930.

By determination of the coefficient of stress s (coefficient of expansion: coefficient of compressibility) and insertion of the values of $a_{\text{liq.}}$ and $b_{\text{liq.}}$ (van der Waals) calculated from the increments, molecular weights in the liquid state may be calculated from the equations—

$$s = \frac{a_{\text{liq.}}}{\left(\frac{M}{d}\right)^2}\cdot\frac{1}{T} \quad \text{and} \quad s = \frac{R}{\frac{M}{d} - b_{\text{liq.}}},$$

R having the value 3·04. Both equations hold for normal substances, and the second serves for the calculation of the association factor. The use of this method is proposed for determining the polymerisation factor of polymerides of high molecular weight. T. H. P.

3027. Classification of the Ground States of Molecules. M. Dunkel. *Zeits. f. phys. Chem.* 7. *Abt. B.* 2. *pp.* 81–107, *March*, 1930.

Using the results of recent physical investigations on the structure of diatomic molecules, a general scheme for classifying the ground states of diatomic and multiatomic molecules is put forward. It is suggested that electrons which in the separated atoms already occupy closed shells, should retain the same quantum numbers in the molecule. The location of the rotational impulse of electrons in many-atomed molecules and the " free rotation of the valency " are discussed. It is pointed out that the increase in energy of closed shells due to resonance, required by quantum mechanics, is the cause of the different valency towards oxygen and hydrogen exhibited by the atoms of the fourth to the eighth vertical series of the periodic table. The " coordination number " is based on the Pauli exclusion principle. The author's classification is applied to the first horizontal series in the periodic table. W. S. S.

3028. Pauli's Exclusion Principle. E. U. Condon and J. E. Mack. *Phys. Rev.* 35. *pp.* 579–582, *March* 15, 1930.

Pauli's exclusion principle can be understood as an instance of the subjectivity of our knowledge. We are built out of only a particular world constructed according to one of the non-combining patterns possible under the laws of quantum mechanics. Therefore we are capable of having sense perceptions of only that world. Dirac's theory of the proton [see Abstract 2416 (1930)] shows why Pauli's principle governs the world. AUTHORS.

3029. Separation of the Angles in the Two-Electron Problem. G. Breit. *Phys. Rev.* 35. *pp.* 569–578, *March* 15, 1930.

For the case of two electrons in a central field (electron spin neglected) the wave equation is six-dimensional. It is shown how by making use of the properties of the angular momentum operators, the wave function for a state with an assigned " orbital " angular momentum can be expressed as a linear combination of products of distance and angle functions, the angle functions being well-known solutions of the wave equation for a symmetrical top. The distance functions satisfy wave equations in three variables, r_1, r_2 and r_{12}. The problem is thus reduced to a three-dimensional one. The case of P terms is worked out in detail. W. S. S.

3030. Current Density in Dirac's Theory of the Electron. T. Sakai. *Phys. Math. Soc., Japan, Proc.* 12. *pp.* 71–74, *March*, 1930. *In English.*

The current density of the electron derived from Schrödinger's wave theory gives, for a stationary state in a central field, a circular current everywhere in the same sense. With the Dirac theory the electron spin is introduced and the corresponding impulse may be parallel or antiparallel to the orbital impulse. This leads to more complicated current distributions in space. These distributions are worked out for a number of stationary states, and show that the current near the centre is mainly governed by the spin, whilst at a sufficient distance it is attributable to the orbital motion. In the intervening region (which is situated at a distance of the order of the radius of a hydrogen atom) certain characteristic features are presented due to the mutual confusion of the spin and orbital circulations. W. S. S.

3031. Connection between Dirac's and Maxwell's Equations. K. Bollert. *Zeits. f. Physik,* 61. 5–6. *pp.* 368–385, 1930.

In a previous paper [see Abstract 3263 (1929)] the author endeavoured to establish a relation between Dirac's and Maxwell's equations. Meanwhile, Lanczos has simplified Dirac's system [see Abstract 525 (1930)]. Now the author shows that Lanczos's equations may be regarded as a special case of Maxwell's equations, namely, where the two groups of Maxwell become identical. In this case energy is emitted only when at least two atomic conditions are excited with different fundamental frequencies, and the energy is of a frequency equal to the difference between the two fundamental frequencies. E. E. F. d'A.

3032. Theory of Interaction of Field and Matter. J. R. Oppenheimer. *Phys. Rev.* 35. *pp.* 461–477, *March* 1, 1930.

The paper develops a method for the systematic integration of the relativistic wave equations for the coupling of electrons and protons with each other and with the electromagnetic field. It is shown that, when the velocity of light is made infinite, these equations reduce to the Schrödinger equation in configuration space for the many body problem. It is further shown that it is impossible on the present theory to eliminate the interaction of a charge with its own field, and that the theory leads to false predictions when it is applied to compute the energy levels and the frequency of the absorption and emission lines of an atom. [See also Abstract 2435 (1930).] AUTHOR.

3033. Equilibrium between Matter and Radiation. L. S. Kassel. *Phys. Rev.* 35. *pp.* 778–781, *April* 1, 1930.

The equilibrium concentration of electrons and protons is recalculated on the basis of Dirac's new theory of the nature of the proton [see Abstract 2416 (1930)]; it is found to be exceedingly small, of the same order of magnitude as had been found in previous calculations. AUTHOR.

3034. Numerical Determination of Characteristic Numbers. W. E. Milne. *Phys. Rev.* 35. *pp.* 863–867, *April* 1, 1930.

A method is developed for the numerical calculation of characteristic energy levels in cases where the wave equation contains, or can be reduced so as to contain, a single space variable. The procedure consists in the numerical integration of an auxiliary differential equation for several chosen values of the energy, after which the characteristic values are obtained by interpolation. The method is one of considerable generality so far as the form of the differential equation is concerned, and is capable of giving any preassigned degree of accuracy. AUTHOR.

3035. Boundary Conditions and the Meaning of Wave Groups in Wave Mechanics. H. A. Wilson. *Phys. Rev.* 35. *pp.* 948–956, *April* 15, 1930.

Reasons are given for believing that the boundary conditions at a discontinuity in the potential (V) in wave mechanics may be $\phi_1 = \phi_2\mu^{1/2}$ and $\phi_1 d\phi_1/dx = \phi_2 d\phi_2/dx$. Here ϕ is the wave function and μ the ratio of the group velocities. With these boundary conditions the waves are either completely transmitted or completely reflected according as the energy E is greater or less than V. The particles, therefore, need not be supposed to enter the region in which $V > E$, where their velocities would be imaginary and their kinetic energies negative. It is suggested that the group of waves associated with a particle should be identified with the

particle and that the energy and momentum of the particle are the energy and momentum of the group of waves. When the group is stopped or absorbed, it contracts to small dimensions and so becomes a particle.
AUTHOR.

3036. Probability of Radiative Transitions. J. R. Oppenheimer. *Phys. Rev.* 35. *pp.* 939–947, *April* 15, 1930.

The author computes the rate at which electrons and protons should, on Dirac's theory of electrons and protons [see Abstract 2416 (1930)], annihilate each other; this gives a mean life for matter of the order of 10^{-10} sec. He also computes by Dirac's radiation theory the relative probability of radiative and radiationless transitions; and obtains an expression ssubtantially equivalent to that derived by Heisenberg and Pauli [see Abstract 2435 (1930)].
AUTHOR.

3037. Two Components Theory of Wave Mechanics. E. Reichenbächer. *Zeits. f. Physik,* 61. 7–8. *pp.* 490–510. 1930.

The theory discussed by the author in a previous paper [see Abstract 925 (1930)] is clarified and developed by means of the Ricci calculus.
J. S. G. T.

3038. Asymmetric Rotator and its Infra-Red Spectrum. C. R. Bailey, A. B. D. Cassie and W. R. Angus. *Faraday Soc., Trans.* 26. *pp.* 197–202, *April,* 1930.

Taking the expressions for the stationary state energies deduced by Lütgemeier [see Abstract 2533 (1926)], using the older quantum theory, for the rotation of a polyatomic molecule with three different moments of inertia, approximate formulæ for the line separations in the infra-red spectrum are derived by differentiation. In making the approximations the numerical values of the moments of inertia of water vapour are assumed. The results show that to a first approximation a number of well-defined frequency separations are obtained, the second approximation giving additional lines with small separations which result in broadening of the main lines and formation of a continuous background. [See also Abstracts 67 and 2433 (1930).]
W. S. S.

3039. Probability Method in the New Statistics. S. Chandrasekhar. *Phil. Mag.* 9. *pp.* 621–624, *April,* 1930.

The two methods generally employed in the treatment of problems in statistical mechanics are (1) the method of the kinetics of collisions and the establishment of a H-theorem, and (2) the method of counting the complexions. A new method has, however, been recently developed by W. S. Kimball [see Abstract 1124, (1930)], a " geometrical weight method," and the present paper is a generalisation of this new method to include the quantum statistics.
T. B.

3040. New Methods in Statistical Mechanics. M. Saha and R. C. Majumdar. *Phil. Mag.* 9. *pp.* 584–589, *April,* 1930.

Reviews the methods of Planck, Bose and Einstein, and of Fermi and Dirac and others in statistical mechanics. It is difficult to see the connection between them, and an attempt is made to supply a link connecting them. A proof is given for the equation, assumed correct by Ehrenfest and Irkal for G, the function given as an alternative to $S = k \log W$ by Boltzmann and Gibbs, G being defined as the total phase volume described by a thermodynamical system. Reduces the calculation of the phase volume from 6N dimensional space to one of 6 dimensions, and shows that the classical expression for entropy is easily obtained from this value of G, and how the Fermi-Dirac expression can be obtained when W, which Planck called the thermodynamical probability, is defined as the maximum number of probable states which can give rise to the total energy E. The treatment differs considerably from that of Brillouin, and has the merit of giving a deduction for the absolute value of S on the three views of classical, Fermi and Fermi-Dirac statistics from a unitary standpoint. The Bose-Einstein statistics have to be ruled out in the case of material particles, while, since it is correct for light particles (photons), it is necessary to assume that when a photon enters a phase space the space expands. [See also following Abstract.] H. N. A.

3041. Generalised Form of Statistics. D. S. Kothari and R. C. Majumdar. *Zeits. f. Physik*, 61. 7–8. *pp.* 538–544, 1930.

This is essentially a summary of a portion of the above paper by Saha and Majumdar [see preceding Abstract].

3042. Boltzmann's Statistical Mechanics as an Approximation to Wave Mechanics. P. Frank and W. Glaser. *Zeits. f. Physik*, 61. 9–10. *pp.* 640–643, 1930.

Born has proposed the following explanation for Schrödinger's wave function ψ; $|\psi|^2 dq_1 \ldots dq_n$ shall, regarded as a function of the co-ordinates, indicate the probability that the system is to be found in the state defined by the coordinates $q_1, q_2 \ldots q_n$ and the element of volume $dq_1, dq_2 \ldots dq_n$; the author shows that if this explanation is accepted the above expression must, in the limiting case of classical mechanics, pass into the expression which Boltzmann has given for the relative time of stay, *Verweilzeit*, of a quasi-ergodic system in a volume element of the phase space. In spite of the fact that the statistical explanation of wave mechanics leads in the limiting case to the old statistical mechanics of the quasi-ergodic system, there is always a possibility that, in a case where classical mechanics gives no approximate solution of a problem (*e.g.*, the behaviour of the electron in a hydrogen atom), $|\psi|^2$ could not be regarded as the probability for the presence of a particle in a definite position, and that the conception of a point-formed particle would then lose its meaning. [See also following Abstract.] H. N. A.

3043. Correspondence Principle and Schrödinger's Wave Function. W. Glaser. *Zeits. f. Physik*, 61. 9–10. *pp.* 644–654, 1930.

Investigates the statistical explanation of Schrödinger's wave function in its relation to the correspondence principle, and shows in a more direct manner than that employed by Frank and Glaser (see preceding Abstract) that Boltzmann's formula for the mean time of stay, *Verweilzeit*, of a mechanical system in a definite phase represents an approximate solution of Schrödinger's wave equation. The Boltzmann formula is deduced by a simplified method. It is found that the differential equation which defines Boltzmann's "system probability," and expresses the fact that the number of mechanical systems is conserved, is identical with that for the first approximation to the wave equation calculated by the Wentzel-Brillouin method. H. N. A.

3044. Further Development of the Kar-Mukherjee Generalised Statistical Theory. K. C. Kar. *Zeits. f. Physik*, 61. 9–10. *pp.* 675–680, 1930.

The Kar-Mukherjee statistical theory [see Abstract 2444 (1930)] is developed on the assumption that not only the phase space but the impulse space also is compressible. J. S. G. T.

3045. Causality Law and Quantum Mechanics. L. Infeld. *Zeits. f. Physik*, 61. 9–10. *pp.* 703–711, 1930.

The physical meaning of Heisenberg's inaccuracy relations, *Ungenauigkeitsrelationen*, has been frequently interpreted in contradictory ways; compare, for example, the interpretations of Heisenberg and of Fürth. These relations are of importance in quantum mechanics in connection with the law of causality, and the author here endeavours to get a better idea of their meaning from a new point of view, which has been proposed by Gaviola, by holding carefully in formulating them either to the wave or the corpuscular position. Comes to a number of interesting conclusions: the dimensions of the electron are only determined by its meeting with a light corpuscle, and are equal to the dimensions of the light corpuscle in question. One should only talk of the electron radius when it is interacting with radiation or with other electrons, just as only relative motion has a physical meaning. The diameter ascribed to electron and light corpuscle (regarded as spheres) is not less than the wave-length of the light employed. Estimates are made of the radii of free electrons moving with a velocity a little less than that of light, about 10^{-10} cm., an electron in a neutron about 10^{-13} cm. In the simplest case, when the system consists of a single non-radiating electron, the idea of the radius of the electron has no meaning. The idea of causality, that of determination of position and that of extension of a body should not and need not be transferred to microphysics in the form in which they are employed in macrophysics. [See also Abstract 509 (1930).] H. N. A.

3046. Scattering of Radiation by Bound and Free Electrons in Dirac's Relativistic Mechanics. I. Waller. *Zeits. f. Physik*, 61. 11–12. *pp.* 837–851, 1930.

Using Dirac's wave equations for the electron and Dirac's quantisation of the electromagnetic field, the scattering of radiation of any wave-length by bound electrons is investigated. The scattering process is effected by absorption followed by emission or vice versa, no true scattering taking place. To obtain the experimentally confirmed scattering formula deduced from the non-relativistic Schrödinger equation, it is shown to be necessary to take into account scattering processes in which the intermediate state of the electron is a state of negative energy. For scattering by free electrons, the investigation leads to the Klein-Nishina formula again taking into account intermediate states of negative energy. If $h\nu/mc^2$ is negligible compared with unity, only intermediate states of negative energy are of importance. W. S. S.

3047. Solutions of Einstein's Gravitational Equations with Axial Symmetry. W. R. Andress. *Roy. Soc., Proc.* 126. *pp.* 592–602, *March* 3, 1930.

Solutions of the equations $G_{\mu\nu} = o$ are given corresponding to any static distribution of matter symmetrical about an axis. It is found possible to determine the metric outside a body completely if the potential of the body is taken to be the Newtonian value. This is equivalent to replacing the actual body by another which agrees with it to a first approximation. To determine the actual body, use is made of Einstein's equations for matter, and the density and stresses of the actual body are computed exactly. Some solutions corresponding to bodies rotating about the axis of symmetry are also given and are arrived at by the same method. The determination of the density and stresses of the actual body is, however, only carried to a second approximation in this case. The result that, by a suitable choice of the angular momentum about the axis of symmetry, the stress in the body due to the attractions of the particles of the system and the " centrifugal force " can be made to vanish in the direction of rotation also follows from this work. G. C. McV.

3048. Gravitational Field of a Variable Mass. H. Mineur. *Comptes Rendus*, 190. *pp*. 625–627, *March* 10, 1930.

The gravitational field of a mass, of which an arbitrary proportion is transformed into luminous energy and radiated in each unit of time, is determined. J. S. G. T.

3049. Significance and Invariance of the Quantum Constant " h " deduced from [the Author's] Gravimetric Theory. T. de Donder. *Comptes Rendus*, 190. *pp*. 731–733, *March* 24, 1930.

The quantum constant " *h* " is shown to be invariant in the author's gravimetric theory, and to be given by the equations $h = mc^2T = m'c^2T'$, when $mV = m'c$ and $T' \equiv cT/V$, the symbols having their customary significance. J. S. G. T.

3050. Physical Interpretation of the Riemannian Tensor and of Principal Curvatures of Class V_3. A. Tonolo. *Comptes Rendus*, 190. *pp*. 787–788, *March* 31, 1930.

The significance of the Riemannian tensor and curvatures is discussed mathematically. J. S. G. T.

3051. Properties of a Unitary Physical Theory. Part II. L. L. Whyte. *Zeits. f. Physik*, 61. 3–4. *pp*. 274–289, 1930.

Measuring rods, clocks and a possible alternative to four-coordinate description are dealt with in this part. The special place of quantum theory in physics is attributed to the fact that the classical and relativistic theories were macroscopic and yielded no precise theory of measurement based on a theory of the structure of matter. The alternative to four coordinate description is based on the postulate: the space-time arrangement of events is derivable from causally linked pairs of coincidences (or the non-occurrence of these). The possibility is discussed of differentiating in coordinate theories between properties which are immediate consequences of the use of coordinates and those which represent an underlying structure of events. [See also Abstract 529 (1930.)]

W. S. S.

3052. Relativistic Electron. R. Zaycoff. *Zeits. f. Physik*, 61. 5–6. *pp*. 395–410, 1930.

The stability of the electron is interpreted in terms of a six-dimensional world geometry. J. S. G. T.

3053. Energy-Momentum Principle in Relativity. R. C. Tolman. *Phys. Rev.* 35. *pp*. 875–895, *April* 15, 1930.

A general account of the general relativity form of the energy-momentum principle and its consequences, some of which are new. In particular a formula, differing somewhat from that of Einstein, for the total density of energy and momentum is given in the form of a divergence, and the relation $U = m$, between the total energy and gravitational mass of an isolated material system, is derived from it. The total energy of an isolated system is also obtained in the form of an integral extended only over that portion of space which is actually occupied by the system. This result is used to obtain an expression for the total energy of a sphere of perfect fluid. The classical expression for the energy of such a sphere follows in the limit from this without recourse to a flat space-time. The paper concludes with the determination of the conditions imposed on those changes from one static state to another which could occur in a non-isolated system forming part of a larger static system, without changing the distribution of matter and radiation outside the boundary, and without contravening the energy-momentum principle as applied to the system as a whole. G. C. McV.

3054. Entropy Principle in General Relativity. R. C. Tolman. *Phys. Rev.* 35. *pp.* 896–903, *April* 15, 1930.

The author develops a general relativity analogue to the second law of thermodynamics based on the existence of an entropy four-vector given at each point of space. The principle is then applied to find the conditions of thermodynamical equilibrium of a finite system, for adiabatic changes from one static state to another. During these changes the conditions holding outside the finite system considered are supposed not to alter. The results obtained are shown to have a specially simple form in the case of spherical symmetry. [See also following Abstract.] G. C. McV.

3055. Thermal Equilibrium in General Relativity. R. C. Tolman. *Phys. Rev.* 35. *pp.* 904–924, *April* 15, 1930.

Starting from the result of special relativity, that mass and energy are equivalent and hence that energy would have weight in a gravitational field, the author investigates the thermodynamic consequences of the idea that heat energy has weight. In particular the question of whether or not a temperature gradient exists in matter or radiation in thermal equilibrium in a gravitational field is investigated. Using a relativistic form of the second law of thermodynamics already given [see preceding Abstract], the relation between the temperature and the gravitational potential of a spherical distribution of perfect fluid in thermal and gravitational equilibrium is found. This relation gives the temperature gradient necessary to prevent a flow of heat from a region of high to a region of low gravitational potential. In the case of black-body radiation mechanical principles alone are sufficient to solve the problem, and the result agrees with that obtained by the new thermodynamic treatment. The method is also applied to the determination of the relation between concentration and temperature of a monatomic gas in a gravitational field. G. C. McV.

3056. Hamilton's Principle and the Field Equations of Radiation. D. Meksyn. *Phil. Mag.* 9. *pp.* 568–577, *April*, 1930.

Solves the problem of finding from Hamilton's principle the most general field laws for an antisymmetric tensor of the second rank in five dimensions. The method of solution is purely formal, and applies to 3, 4 and 5 dimensions, giving in each case the electrostatic, the electromagnetic and the radiation field equations. The equations obtained for five dimensions represent a formal generalisation of those of Maxwell. It appears that the five-dimensional continuum represents a natural system of reference for radiation phenomena. H. N. A.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

3057. Measurements of the Albedo of a Snow Cover. N. N. Kalitin. *Monthly Weather Rev.* 58. *pp.* 59–61, *Feb.*, 1930.

Observations were made near Leningrad, February to May, 1929, the snow cover having disappeared in the last month and changes in the vegetative cover of the ground occurred. An Angström pyranometer was used in conjunction with a Zeiss loop galvanometer. The mean results are tabulated and the albedo shown as a graph for the period. The reflective capacity of the snow depends on its form and state, age, winds and thaw decreasing it. R. S. R.

3058. Mean Atmospheric Pressure, Cloudiness and Sea-Surface Temperature of the North Pacific Ocean. K. Tsukuda. *Imp. Marine Obs., Kobe, Japan, Mem.* 2. *pp.* 163–201, *March*, 1930. *In English.*

Observations obtained from ships and from land stations have been employed to calculate mean values for each 5° square of the Pacific. In winter the lowest sea-surface temperature is found near the Kuriles or south of Kamchatka, and in summer near the middle part of the Aleutian Group. At the Kuriles the annual range is 13° C., and near the Equator 3° C. Mean cloudiness decreases southwards, being a maximum near the Aleutian Islands of 8/10 or more, and in the summer season more than 9/10. These results are compared with those obtained by Brooks. The mean values of the three elements are tabulated in 5° squares for the year and each month, and shown also graphically month by month. R. S. R.

3059. Rôle of the Oceans in the Weather of Western Europe. C. E. P. Brooks. *Roy. Meteorolog. Soc., J.* 56. *pp.* 131–140, *April*, 1930.

The author explains how the strength of the Gulf Stream, and consequently the surface-water temperature in the N. Atlantic, depends upon the strength of the N.E. and S.E. trade winds. An increase in the wind speed raises the water temperature several months later and consequently affects the wind circulation over the N. Atlantic and the weather over W. Europe. This water temperature is affected also by changes in the Labrador and E. Greenland currents. Examination of the amount of ice in the Kara, Barents and Greenland Seas has given an " ice index " for the Arctic Ocean. The relation of this " ice index " from 1895 to 1928 to the subsequent pressure at Valentia is shown. The ice tends to raise the pressure by cooling the air, but to lower it by an increased pressure gradient and increased circulation, the former being of importance in summer and the latter in January to March. Examples are given of these several factors influencing the weather of the British Isles. R. S. R.

3060. Problem in Wind-Stream Theory. J. E. Fjeldstad. *Zeits. f. angew. Math. u. Mechanik,* 10. *pp.* 121–137, *April*, 1930.

The excitation of motion in an unbounded, plane free ocean by a wind, uniform in strength and direction, but a function of the time, is discussed mathematically. J. S. G. T.

3061. Periodicity. Part III. Criteria for Reality. G. T. Walker. *Roy. Meteorolog. Soc., Mem.* 3. *pp.* 97–101, *April*, 1930.

The author refers to Schuster's criterion and his own [see Abstract 280

(1928)] regarding the examination of data for periodicity, and to make the subject more concrete and practical he describes a quantity of calculations performed on chance numbers. Five sets of 120 random numbers are used and give Fourier amplitudes so large that if Schuster's criterion is applied alone reality of the periods must be accepted. Finally, criticisms by Brunt of the author's criterion are examined. R. S. R.

3062. Comparison of Temperatures in Stevenson Screens at Heights of 6 ft., 4 ft. and 2 ft. K. R. Ramanathan. *Indian Meteorolog. Dept., Sci. Notes*, 1. 9. pp. 113–121, 1929.

Observations of dry- and wet-bulb, maximum, and minimum thermometers were made at Agra in screens at the three heights. Humidities varied very little from one screen to the other. For the 6-ft. screen dry-bulb temperature November to January was 0·2° F. higher than in the standard screen, while in the 2-ft. screen it was generally 0·2° F. higher. Maximum temperatures decrease in the order, 2 ft., 4 ft., 6 ft., the difference being least in winter and greater in summer. An inversion was found in the first 6 ft. each morning in each month. The increase of temperature is greatest near the ground. The inversion is least in the monsoon, a maximum in the hot season and decreases with increasing cloud amount. R. S. R.

3063. Temperatures Inside Painted and Unpainted Stevenson Screens. B. Ali. *Indian Meteorolog. Dept., Sci. Notes*, 2. 11. *pp.* 1–11, 1930.

Observations at Agra of maximum, minimum and dry-bulb temperatures and of humidity were made for six months in Stevenson screens (i) painted white, (ii)unpainted and (iii) painted black, to determine whether changes in the colour or condition of the paint affected the observations obtained. Relative humidity and minimum temperature were unaffected. Dry-bulb temperature at 8 a.m. and the maximum in the black screen exceeded those in the white screen by 0·2° F. and 0·8° F. respectively, the latter being mostly 0·4° F. to 0·6° F. The excess decreases as the wind strengthens. Temperatures for white and unpainted screens are almost the same. R. S. R.

3064. Horizontal Component of Radiation. M. Toperczer. *Gerlands Beitr. z. Geophys.* 26. 1. *pp.* 98–110, 1930.

The author deals with the radiation received on the surface of a vertical cylinder of unit dimensions, this being considered of more importance in everyday life. Mean values of this horizontal component D of solar radiation, where $D = J \cos h$, are tabulated for each month and hourly from 5 to 18 hours for Arosa. The maximum occurs in winter, and the minimum in summer, the former being twice the latter. With the seasonal change, winter to summer, the daily maximum shifts from midday to early morning and evening. The daily variation is greater in summer. Mean monthly values of the total heat (W) received, and the horizontal (W_D) and vertical (W_B) components are compared, and ratios of these quantities given. W_D is greatest in May and August, and it has a smaller oscillation than the other two quantities. For ultra-violet radiation the values of D show variations similar to those for solar radiation, there being maxima in May and August and a retreat in summer for the maximum away from midday. The daily oscillation is, however, greater. Finally, theoretical relations are obtained for the radiation from the sky. R. S. R.

3065. Report of Tenth and Eleventh Annual Meetings of American Geophysical Union. *National Research Council, Washington, D.C.* [314 *pp.*], *April*, 1929, *and May*, 1930.

3066. Mean Density of the Crust of the Earth. G. Tiercy. *Arch. des Sciences*, 12. *pp.* 115–128, *March–April*, 1930.

Adopting Wavre's value for the ellipticity of the earth (1/294) and 1/288·42 as the ratio of the centrifugal force to gravity at the equator, and assuming that the density increases continuously from surface to centre and is a function of radius and latitude, by aid of Clairaut's equation and Roche's hypothesis, the values 2·6 and 9·9 are deduced for the mean density at the surface and centre of the earth respectively. C. A. S.

3067. Reduction of Values of Gravity. F. Hopfner. *Gerlands Beitr. z. Geophys.* 26. 1. *pp.* 51–57, 1930.

The author shows that if observed values of gravity are reduced by the isostatic method to levels of different potential, according to the elevation of the observed station above sea-level, or by the methods of Bouguer or the free air formula of Fay, the results obtained are as a rule not free from objection. The possibility of differences in the results of Bossolasco and Heiskanen being accounted for in this way is considered. R. S. R.

3068. Three-Axial Character of Earth's Figure and Basis of Laws of Isostasy. F. Hopfner. *Phys. Zeits.* 31. *pp.* 289–296, *April* 1, 1930.

The author deals first with the results obtained by Heiskanen, Helmert and Berroth, on axial diameters and the equations giving the mathematics of the earth's figure. Expressions are given for the dependence of the force of gravity on local mass distribution. Phenomena resulting from the isostatic reduction procedure are next taken and reference made to Hayford's ellipsoid, and the measurement of the degree in India by Chrostwait and in Europe by Heiskanen. The results of Bossolasco, Mader and Schwinner lead to considerable doubts regarding the theory since isostatic mass superposition is not everywhere uniform, wide regions are partially or not at all compensated and the depth of the place of uniform pressure is not constant. The sources of error in the application of the facts are considered. Finally, the causes of differences in the oceanic and continental values of gravity are examined, and by suitable use of the equations the laws of isostasy are shown to be satisfied. R. S. R.

3069. Axial Oscillations of the Earth and their Results. R. Spitaler. *Gerlands Beitr. z. Geophys.* 26. 1. *pp.* 94–97, 1930.

The author considers that displacement of air masses and oscillations of the earth's axis may act interchangeably as cause and effect. The air mass displacements produce the average weather conditions and are caused by the distribution of land and water in the two hemispheres. Radau and Helmert have shown that by a resonance effect this air mass transport increases 6-fold the polar oscillation, thus causing changes in centrifugal forces and earthquakes. The influence of these oscillations in geological times is considered for different distributions of land and water, and the resulting polar oscillation is compared with that found by Radau and Helmert. [See also Abstract 2462 (1930).] R. S. R.

3070. Approximate Formulæ for Amplitude of Waves Resulting from Passage of a Given Wave Through a Surface of Discontinuity. H. P. Berlage, Jr. *Gerlands Beitr. z. Geophys.* 26. 2. *pp.* 131–140, 1930.

From Zoeppritz's matrix formulæ for the relation between the amplitudes of reflected and refracted condensational and distortional waves (*Nachrichten, Göttingen*, 66, 1919), approximate formulæ are deduced which are accurate where γ [= (density of × velocity in second medium)/(density of × velocity in first medium)] is 0, 1 or ∞, or where the angle of incidence is 0° or 90°; and in general correct within 10% of the amplitude of the incident wave. Similar formulæ for the case of an incident distortional wave polarised in the plane of incidence are also worked out. These results are illustrated by two examples. C. A. S.

3071. Determination of the Epicentre of a Near Earthquake. J. Neunteufl. *Gerlands Beitr. z. Geophys.* 26. 2. *pp.* 189–198, 1930.

An enquiry into the reliability of the hyperbola formula of A. Mohorovičič. If t_1 and t_2 denote the times of arrival of a certain wave at stations I and II, situated at distances r_1 and r_2 from the unknown epicentre, then $r_2 - r_1 = v_0 (t_2 - t_1)$, where v_0 is the apparent velocity of the surface wave; the distance $(r_2 - r_1)$ may be regarded as the major axis of a hyperbola, the foci of which are I and II and which is the focus of all the possible positions of the epicentre. The paths of the waves should be rectilinear. For P_n and for distances up to 1000 km. v_0 is approximately 8 km., for the wave $\overline{P}$ and distances above 100 km., about 5·6 km.; but v_0 varies with the district. The author finds that a definite value for the position of the epicentre can be deduced from observations at three stations; to judge the probable accuracy of the estimate, however, observations from at least four stations should be available. The data are taken from Alpine and Apennine earthquakes. H. B.

3072. Development of the Wave Conception. Part III. K. Uller. *Gerlands Beitr. z. Geophys*, 26. 2. *pp.* 199–238, 1930.

It is impossible from field equations alone to construct a wave, since only the velocity of a wave-front (or rear) can be so evaluated in favourable cases; and the field equations are only the mathematical conception of the physical laws. The present paper, which continues previous work [see Abstract 1362 (1930)], discusses the various aspects of wave conception under the headings: field and wave; wave kinematics; physical wave kinematics; interference—principle for waves of elementary variational form in isotropic, continuous inhomogeneous media; application limits of the Fermat principle; Huygens-Kirchhoff theorem. It is shown that the formal has nothing to do with the physical nature of the waves, and that variable fields are waves when kinematically considered. The Huygens-Kirchhoff theorem is proved to be without significance for wave theory. H. H. Ho.

3073. Love Waves in the Chilean Earthquake of November 11, 1922. P. Byerly. *Am. J. Sci.* 19. *pp.* 274–282, *April*, 1930.

The conclusion arrived at in the last communication [see Abstract 79 (1929)], that an impulsive force acting at the epicentre and directed within limits indicated would have been a sufficient cause for the first movement of the earthquake as recorded at stations all over the earth, involved the assumption that the first preliminary wave started at the source of the quake and travelled to the stations without any reflection which might have introduced a change of phase. This assumption, *i.e.*, the absence of reflection, is now examined. In certain British earthquakes Jeffreys found that the energy released at the focus was in the form of shear waves, and that the first preliminary waves registered were the product of the incidence at the earth's surface of these primal S′ waves, which preceded the P waves by several seconds. In order to test whether the P waves were reflection phenomena the author tried to identify the direction of the first motion of the Love waves. The Love waves of the seismograms approximate the theoretical wave of Love, which is a shear wave with the vibration in the horizontal phase transverse to the direction of propagation. Assuming that the Love waves have their original source in the SH wave, due to the horizontal component of the original shear at the focus, he finds that the first motion was at all the 20 stations (except one) to the left, and that a slip along a fault, the direction of which is roughly determined, would be a sufficient source of the shearing couple. The P waves would be reflected waves. H. B.

3074. Semi-Diurnal Lunar Tidal Motion of the Red Sea. S. F. Grace. *Roy. Astron. Soc., M.N., Geophys. Suppt.* 2. *pp.* 273–296, *April*, 1930.

A recomputation is made of the semi-diurnal lunar tidal motion in the Red Sea and the possibility is examined of the existence of an earth-tide of amount capable of affecting appreciably the theoretical discussion of the M_2 tide. The discussion is hampered by the possibility of small errors in the observational data and a long series of observations at frequent intervals along the Sea is needed to decide. There are indications of an earth-tide dependent on local astronomical forces. In the Gulf of Suez the agreement between theory and observations is not good possibly due to transverse motion and frictional influences. In a table are given the observed and calculated elevation and phase along the Red Sea and also those obtained by Defant and Chandon. There is fair agreement with the latter for most of the Red Sea. In agreement with Sterneck's conclusion over most of the Red Sea the ratio of forced oscillation to co-oscillation is about 1 : 3.3. R. S. R.

3075. Dynamical Tides with Continents. Law for any Depth and Attraction of the Cushion. M. Brillouin. *Comptes Rendus*, 190. *pp.* 778-781, March 31 *and pp.* 840–843, *April* 7, 1930.

The author employs a simplified procedure using spherical coordinates to obtain the general equations for the Newtonian potential and the dynamical equations for the accelerations of any point. For small forced vibrations the expressions contain the potential for all forces as the only unknown function, and this is developed according to the first power of the depth. The attraction of the atmospheric cushion is dealt with and the second derivative of the potential with the depth obtained in terms of known quantities and the variation with latitude and longitude. The components of speed are found to the first order and of pressure to the second order of the depth. [See Abstracts 3501 (1929) and 83 (1930).]

R. S. R.

3076. Continental Drift. P. Stephan. *Phys. Zeits.* 31. *pp.* 385–391, *April* 15, 1930.

The forces causing continental drift on Wegener's theory are investigated. The fact that geoidal surfaces are not parallel sets up forces at different levels within the earth's crust. These would operate at the level of isostatic compensation to cause movement (both of rotation and translation) in floating continental masses. These forces would apparently be sufficient to give the continental drift. W. A. R.

3077. Total Eclipse of Sun, May 9, 1929. R. L. Waterfield. *Roy. Astron. Soc., M.N.*90. *pp.* 605–610, *April,* 1930.

Report of the Johns Hopkins University Eclipse Expedition to the Philippines. The photographs obtained were damaged by cloud, the flash spectra turning out particularly unsatisfactorily. The coronagraph photographs on panchromatic plates were less affected by the clouds being present, and a long-exposure coronagraph photograph with an infra-red plate hardly at all. The observers conclude that the shape of the inner and middle corona is the same in visual and nearly infra-red light. Also that the infra-red light in the corona falls off much more rapidly on passing radially outwards than does the visual light. G. C. McV.

3078. Spectrophotometric Examination of the Absorption of Helium in Sunspots and Faculæ. N. Perrakis. *J. de Physique et le Radium,* 1. *pp.* 126–131, *April,* 1930.

Examines spectrophotometrically the absorption of the helium line D_3, 5875·618 Å., in the sunspots and the faculæ. This study gives a much greater precision than the older visual methods, in spite of its essentially qualitative character. From the results it is concluded that the ray D_3 is generally observed in the immediate neighbourhood of the sunspots or in the spaces between members of a group. The observation of this ray, which is normally difficult to position, can be entirely falsified by the immediate nearness of an atmospheric ray. Further, a weak absorption of helium can be observed in the faculæ near to which no spots can be observed. In other respects this absorption in the faculæ possesses the same properties as that in the sunspots. R. C. F.

3079. Ratio of Number of Ca^+ Atoms in Solar Atmosphere over Faculæ and over Corresponding Parts of Surface near the Limb. P. Kremer. *K. Akad. Amsterdam, Proc.* 33. 4. *pp.* 379–388, 1930.

A comparison of intensities of the contours of H- and K-lines in faculæ and of the same lines in an undisturbed part of the solar surface at equal distances from the limb. From these experimental intensities it is deduced theoretically that the number of Ca^+ atoms over a facula is smaller than over a corresponding undisturbed part of the photosphere. It cannot definitely be established whether this result is due to a change in one of the following: either the temperature, the pressure or the depth of the atmosphere, or whether it is the result to a combined variation of all three. G. C. McV.

3080. Deflection of Light as Observed at Total Solar Eclipses. C. L. Poor. *J.O.S.A.* 20. *pp.* 173–211, *April,* 1930.

The author considers that the results obtained by eclipse expeditions relating to the Einstein deflection can neither prove nor disprove the relativity theory. Experimental errors have been only imperfectly eliminated; the data employed have been subjected to a process of selection; non-radial components of the actual measures have been discarded as " accidental errors." The actual stellar displacements, if real, do not show the slightest resemblance to the predicted Einstein deflections. J. S. G. T.

3081. Comparison of Laboratory and Solar Wave-Lengths. K. Burns. *J.O.S.A.* 20. *pp.* 212–224, *April,* 1930.

The author considers that Einstein's prediction of a red shift of solar lines amounting to 21 parts per 10,000,000 has not been established for all solar lines. The sharpest lines show very small shifts, and the shifts of all lines of all intensities are small in the spectral regions where the observations are best. The intensity equation is partly due to instrumental error, and the elimination of this error would leave the shifts smaller than at present supposed. St. John's velocity explanation of the intensity equation appears to be untenable in the light of atomic theory.

J. S. G. T.

3082. Observed Motion of the Perihelion of Mercury. H. R. Morgan. *J.O.S.A.* 20. *pp.* 225–229, *April*, 1930.

Calculations of the perturbations of Mercury's orbit by Leverrier, Newcomb, Hill, Doolittle and the U.S. Naval Observatory (1900–1925) are briefly and critically reviewed. The value of the residual in the secular variation of longitude of the perihelion of Mercury, calculated from the latest observations is 50″·9. Various contributory causes of this residual are examined. The difference between this observed value and the Einstein value, 42″·9, is four times the probable error. J. S. G. T.

3083. Problem of Colour Index in Physical Astronomy. P. Rossier. *Arch. des. Sciences*, 12. *pp.* 61–85, *Jan.-Feb., and pp.* 129–146, *March-April*, 1930.

Mathematically examines the question of the colour index considering three types of energy receivers—the photographic plate, the eye and the photoelectric cell. A reasonable degree of accuracy, especially for giant stars, can be attained on the assumption that the radiation of the stars can be compared with that of a black body. It is shown that the accuracy of the measurements should be increased and that the sensitivity of the receivers should be studied completely under conditions approximating to astronomical observation conditions. The latter is especially necessary for the eye, owing to the " personal photometric equation " being variable. Knowledge of the sensibility curve enables the reduction of photometric observation to bolometer magnitudes to be done, thus allowing of comparisons of readings taken by various observers. This reduction is performed by calculating the absolute colour index of the receiver utilised. The terrestrial atmosphere mitigates against the obtaining of very certain results, and an improvement of the knowledge of extinction, at the moment of observation, is very desirable. R. C. F.

3084. Non-Harmonic Analysis of Secular Inequalities in Planetary Motions. A. Wintner. *Accad. Lincei, Atti*, 11. *pp.* 464–467, *March* 2, 1930. *In French.*

It is known from Lagrange's work that the secular irregularities in the perihelia and nodes of the great planets have a mean motion, provided that a certain condition is fulfilled, as it is in fact for most of the planets. The existence of a mean motion implies that the angular coordinate δ is of the form $\gamma t + \alpha(t)$, where γ is a constant and $\alpha(t)$ is a function which remains bounded for all values of t, however great. It has usually been assumed that $\alpha(t)$ would have a more or less marked oscillatory character, and it is here proved that it is quasi-periodic, the difference between its upper and lower limits not exceeding π. J. H. A.

3085. Connection of Mass with Luminosity for Stars. J. Larmor. *Observatory*, 53. *pp.* 113–119, *April*, 1930.

A re-interpretation of a recent theory of Milne [see Abstract 1382 (1930)] of the connection between surface stellar radiation and mass. In Milne's theory the quantity $C \propto P^{-1}(d\rho/dr)^2$, P = pressure, ρ = density, is implied to remain constant at every interface between the various layers in the photosphere. It is now shown that this condition can be replaced by the assumption that the quantity $1 - \beta$, the ratio of the radiation pressure to the total pressure, approaches a limit slowly in the photosphere, so that it can be considered as keeping this limiting value for all the layers therein. Milne accepts this interpretation of his argument. G. C. McV.

3086. Dynamics of Globular Star Clusters. T. Matukuma. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 133–136, *April*, 1930. *In French.*

A calculation of the density in the interior of a globular star cluster, the cluster being assumed (*a*) to be in a permanent state, (*b*) to have spherical symmetry, (*c*) at each point in the cluster to have an ellipsoidal distribution of velocities. The work is a simplification of Eddington's solution. A table of numerical values of the densities is given. G. C. McV.

3087. Rotation of Local Cluster and of Galaxy. H. and Mme. Mineur. *Comptes Rendus*, 190. *pp.* 1050–1052, *May* 5, 1930.

The authors give a table of the mean distance in parsecs of the stars, and the longitude of the centre of rotation, $G_{0,1}$ deduced from b_3 and b_4 and $G_{0,2}$ deduced from b_1 and b_2. The first ($G_{0,1}$) gives the longitude of the centre either at 240° or 330°; the second ($G_{0,2}$) removes the indetermination, as the nearer groups give it at 240° (being the local cluster), decreasing to 150° for the more distant groups. It is shown that these results are not due to chance or to star streaming, for the apex is determined by classifying the stars into 48 groups according to their galactic latitudes, and these indicate clearly the second asymmetrical drift directed towards longitude 330°. A. S. D. M.

3088. Equilibrium of Dense Stars. E. C. Stoner, *Phil. Mag.* 9. *pp.* 944–963, *April*, 1930.

A rigorous treatment, taking relativity change of mass into account, of the problem of the limiting equilibrium of dense stars, already treated in a non-relativity manner [see Abstract 1488 (1929)]. The atoms in the stars are supposed to be completely ionised and the limiting state occurs when the decrease in gravitational energy on contraction is equal to the increase in the total kinetic energy of the electron gas. For spheres of uniform density, it is found that the limiting density varies, with increasing mass, at first as the square of the mass, then more rapidly until a limiting mass is reached after which the kind of equilibrium considered breaks down. The distribution of density in condensed stars is shown to be polytropic and also it is deduced from the data for known white dwarfs that the generation of energy per gm. in these stars is not simply related to the mass of the star. G. C. McV.

3089. Temperatures of Giant and Dwarf Stars. B. Sticker. *Zeits. f. Physik*, 61. 7–8. *pp.* 557–562, 1930.

The differences in temperature between the atmospheres of giant and dwarf stars of similar spectral classes have been studied recently by several investigators, but their results are only qualitative, and do not always agree well. This is because the stars have not been classified according to absolute magnitude as well as spectral class. When this is done, and exact numerical data are used, based on the author's previous work on colour-differences between giants and dwarfs, it is clear that the character of the relation spectral-type/temperature varies according to absolute magnitude. M. A. E.

3090. Absolute Magnitude of Certain Double Stars. P. Salet. *Bull. Astronomique*, 6. 2. *pp.* 115–118, 1930.

Stars such as 289 Jonckheere of rapid motion (60 to 80 years), of separation 1″·3, and estimated magnitudes not greater than 10 or 11, are of great theoretical importance for the determination of the mass-luminosity relation. The author computes, so as to find the absolute magnitude, the hypothetical parallax p, and then $m'_1, = 5 \log p_1 + m' + 5$, where m' is the apparent magnitude corrected so as to give the bolometric. He then computes $\Delta m'$ by tables, both on Eddington's theoretical curve [see Abstract 2324 (1928)] and by the formula, $\Delta m'_1, = 5\,(m'_1, - \beta - 0{\cdot}3a - a\mathrm{K}) \times (3a - 5)^{-1}$. This last gives for 289 Jonckherre, $m'_0 = 9{\cdot}2$, and for B.G.C. 2936 (whose separation is less than 0″·8 and shows no sensible relative motion in a century, having a revolution more than 10,000 years) an absolute magnitude of $-4{\cdot}2$: for the principal companion. A. S. D. M.

3091. Evolution of the Universe. N. Perrakis. *Bull. Astronomique*, 6. 2. *pp.* 127–128, 1930.

Jeans, and later Zwicky [see Abstract 2953 (1928)] have expressed the opinion that the universe is undergoing a unidirectional transformation, and that its entropy is constantly increasing. The author points out that the postulate of Clausius gives information about the value of the entropy of a system in its initial and final states, which are states of equilibrium, but no information about a system which is in a state of transformation. It is thus impossible to state that the entropy of the universe increases continually, since one can only speak of entropy when one is dealing with states of equilibrium. It is possible that statistical thermodynamics, in which it is assumed that the entropy S is an increasing function of the probability W($\mathrm{S} = k \log \mathrm{W}$), may enable a definite meaning to be assigned to the opinion of Jeans and Zwicky, though even here there are difficulties. H. N. A.

3092. Ursa Major Star Drift. J. M. Mohr. *Bull. Astronomique*, 6. 3. *pp.* 147–153, 1930.

The author uses 127 B-stars, 219 A-stars and 238 F-stars, and finds a relation for the A and F stars in the Ursa Major group. Until lately, the numbers in this star drift were few, and Rasmuson only utilised 19 out of a total of 28. This was because the study was based on radial velocities or proper motions. The author is able to give a list of 77 stars of types A-F whose motions are parallel to those considered by Rasmuson, which also certainly belong to the Ursa Major drift. He gives two diagrams of the stellar velocities in the XY and XZ galactic planes, and the dimensions in space of these are of the order $\pi = 0''{\cdot}010$. For the motion of the entire group obtained from 96 stars, he obtains in kilometres: $\mathrm{X}_0 = +30{\cdot}1 \pm 11{\cdot}3$; $\mathrm{Y}_0 = +0{\cdot}9 \pm 5{\cdot}4$; $\mathrm{Z}_0 = -0{\cdot}5 \pm 7{\cdot}2$. For the point of convergence: $\alpha = 297^\circ{\cdot}7$, $\delta = -34^\circ{\cdot}5$, $\mathrm{V} = 16{\cdot}7$ km., as compared with the same point from the 19 Rasmuson stars only: $\alpha = 304{\cdot}3$, $\delta = -35^\circ{\cdot}4$, $\mathrm{V} = 19{\cdot}5$ km. A. S. D. M.

3093. Effect of Annihilation of Matter on Wave-Length of Light from Nebulæ. R. C. Tolman. *Nat. Acad. Sci., Proc.* 16. *pp.* 320–337, *April*, 1930.

The model of the universe employed is that of a homogeneous distribution of matter and radiation with a continuous increase in the radiation at the expense of the matter. In place of the static line elements of Einstein and de Sitter the following non-static form is derived:

$$ds^2 = -\frac{e^{2kt}}{\left(1 + \frac{4r^2}{R^2}\right)^2}(dx^2 + dy^2 + dz^2) + dt^2.$$

On the basis of this line element it is deduced that the rate of transformation of matter into radiation $\left(-\frac{1}{M}\frac{dM}{dt}\right)_{t=0}$ is given by $3k$, and the magnitude of the red shift $\frac{\delta\lambda}{\lambda}$ by $k\,.\,\Delta l$, where Δl is the distance between the nebula and the earth. The value of k deduced from the red shift equals $5\cdot 1 \times 10^{-10}$ (years)$^{-1}$, and the values deduced from $\left(-\frac{1}{M}\frac{dM}{dt}\right)$ as given by Jeans for a series of typical stars, range from $2\cdot 3\,.\,10^{-16}$ to $1\cdot 3\,.\,10^{-10}$ (years)$^{-1}$. It is concluded that the non-static line element may explain, wholly or in part, the red shift in the light from extra-galactic nebulæ. W. S. S.

3094. Monochromatic Images of Orion Nebula. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 90. *pp.* 580–588, *April*, 1930.

The paper deals with the monochromatic images of the Orion nebula obtained during the winter 1929–1930 at the Norman Lockyer Observatory with a 9-inch prismatic camera of large dispersion. Some of the photographs are reproduced and tables of the wave-lengths and intensities of the images are given. These images show that the radiation from the central portion of the nebula is almost entirely due to hydrogen and to the nebular lines N1 and N2, which are due to *O* III; that from the Messierian branch is due to the above together with λ3727 or *O* II; whilst that from the outlying regions is almost solely composed of λ3727. In the main, these researches confirm those of earlier observers. G. C. McV.

3095. Mechanics of Emission of Bright Hydrogen Lines in Gaseous Nebulæ. J. A. Carroll. *Roy. Astron. Soc., M.N.* 90. *pp.* 588–605, *April*, 1930.

A calculation of the number of hydrogen atoms per c.c. in a state of total quantum number *s* at any moment, in a nebula whose density is of the order of 10^{-21} gm./c.c., is given together with formulæ for the intensities of the Balmer lines. Tables of numerical values are also given and the results compared with experimental values due to Plaskett. It is concluded that the H atoms are nearly all ionised, the mechanism of ionisation being photoelectric rather than electron collision or line absorption. The temperature is of the order of 10,000° and the Balmer emission lines are generated by electron capture by ionised atoms and their subsequent transitions. Lyman absorption has little effect on the production of Balmer lines. G. C. McV.

LIGHT.

3096. Grain Size and Radiation Characteristics of Non-Metals. F. Skaupy and G. Liebmann. *Phys. Zeits.* 31. *pp.* 373–374, *April* 15, 1930.

A qualitative study of the absorption A_λ as a function of grain size (single crystals, coarsely crystalline, finely crystalline). (1) For a given wave-length λ, A_λ increases to a maximum with decreasing grain size, and then diminishes. A_λ (max.) is the greater the greater the absorption index of the homogeneous substance. The position of the maximum should be independent of the absorption index, but is always a function of the index of refraction. (2) A_λ as a function of λ. For the region of wave-lengths corresponding to an absorption band, the value of A_λ for a single crystal is greater than for the same substance when polycrystalline. From the curves, suggestions are made for use in illumination technique. F. I. G. R.

3097. Connection between Line-Absorption and Brightness in the Arc. C. Weiss. *Ann. d. Physik*, 4. 7. *pp.* 923–942, *April* 15, 1930.

If the intensity of the light from a layer of luminous gas is I, and from a layer of twice the thickness is I′, then $\frac{I}{I'} = 2 - A_L$, where A_L is the line-absorption. A_L has only been investigated so far in the case of coloured flames, of relatively low temperature. In the present paper the line-absorption is examined in arcs, and the quotient $\frac{I}{I'}$ is expressed as a function of the line-intensity, *i.e.*, $k = f(I)$. It is found that there is a function $k = f(I)$ which gives rise to values agreeing within experimental error with those calculated by Ladenburg and Reiche. A. C. M.

3098. Chromoptometry. Theoretical Interest and Practical Applications. J. L. Pech. *Rev. d'Optique*, 9. *pp.* 49–58, *Feb.*, 1930.

After a survey of earlier results the author explains the methods employed in a study of ocular refraction. Peter's ericiscope is the best form, permitting an optical examination of the eye using extreme colours in the visible spectrum. Two adjacent screens are illuminated one with light between 4190 and 5650 Å. and the other 6000 to 7200 Å. The human eye is myopic for violet and blue, slightly so for green, practically emmetropic for yellow and practically hypermetropic for red. The total accommodation of the eye depends upon (1) deformation of the crystalline lens, which is voluntary, and (2) chromatic aberration, which is purely physical. The variation of these factors for different individuals and their change with fatigue and general bodily condition are discussed. R. S. R.

3099. Reduction of Data on Mixture of Colour Stimuli. D. B. Judd. *Bureau of Standards, J. of Research*, 4. *pp.* 515–548, *April*, 1930.

The most fundamental set of data relating to colour vision is embodied in the three excitation or distribution curves by means of which the laws of mixture of colour stimuli are applied. The first set of distribution curves to which luminosity coefficients were attached was compiled from

König's data by Ives. The author uses in the paper one set of distribution curves [see Abstract 2065 (1925)] which will sum, when properly weighted, to a satisfactory approximation of the accepted luminosity function of the source. He proceeds to prove that any one of the infinite number of sets of distribution curves representing a given body of mixture data will sum equally well to the luminosity function. Two methods for computing the luminosity coefficients of any of these sets of distribution curves are given, and four examples of this problem are solved by these methods. It is then demonstrated that the new sets of distribution curves embody the mixture data of the O.A.S. "excitation" curves, and shown that one of these sets of curves embodies greater computational convenience than any previously proposed set. A graphical interpretation is given. The paper contains many illustrations and copious footnotes. T. C. H.

3100. Diffusion of Light by Polished Surfaces. J. Urbanek. *Comptes Rendus,* 190. *pp.* 862–864, *April* 7, 1930. *Rev. d'Optique,* 9. *pp.* 247–262, *June-July, et seq.* 1930.

A study of the diffusion of light by polished surfaces by means of a photographic method. J. J. S.

3101. Diffraction. E. T. Hanson. *Roy. Soc., Phil. Trans.* 229. *pp.* 87–124, *April* 17, 1930.

The problem of the effect of obstacles, bounded by two-dimensional surfaces, on plane sound or plane electromagnetic waves travelling in any prescribed direction is analysed mathematically. C. B. A.

3102. Ultra-Violet Tyndall Cone of Pure Water. H. Schade and H. Lohfert. *Kolloid Zeits.* 51. *pp.* 65–71, *April,* 1930.

The relation between the purity of water and the intensity of the Tyndall cone produced by the scattering of ultra-violet light traversing the water is investigated by photography and photoelectric measurements. Water purified by repeated distillation shows only an extremely faint Tyndall cone when traversed by visible light, but using ultra-violet light the cone is readily detected photographically even with the purest water. Quantitative photoelectric measurements show that repeated distillation of the water leads to a constant value for the intensity of the ultra-violet Tyndall cone. With rising temperature the intensity decreases rapidly in pure water up to 20° C. and less rapidly from 20 to 90° C., these changes being reversible, while in unpurified water the effect of temperature is variable. Addition of small amounts of pure electrolytes (LiCl, NaCl, KCl) to pure water reduces the intensity of the ultra-violet Tyndall cone. There is a close analogy between the curves representing the variation with temperature of the intensity of the ultra-violet Tyndall cone and of the viscosity. These results indicate that the ultra-violet Tyndall cone in purified water is to be attributed to the presence of polymers of water molecules. The larger polymers may approach colloidal dimensions. A. J. M.

3103. Longitudinal Light Scattering in Passing Through Various Media. J. Plotnikow and L. Šplait. *Phys. Zeits.* 31. *pp.* 369–372, *April* 15, 1930.

The transverse scattering of light of different wave-lengths, involving the Compton effect in X-rays and the Raman effect in the visible and ultra-violet, has been well examined, whilst the Tyndall effect in passing through suspensions is also well known. This paper deals with the unexplored region of long waves and substances of high molecular weight. It is found that there is a longitudinal scattering, so that a parallel beam broadens in a conical form and its volume increases. The higher the molecular weight of the medium, the longer the waves which can show the effect; it has been studied in the visible and infra-red with more than fifteen substances and the results are set out in tabular form, typical photographs also being shown. J. H. A.

3104. Polarisation, Light Scattering, Photoelectric and Compton Effects, according to the "Tube of Force" Theory of Light Quants. W. Anderson. *Zeits. f. Physik*, 61. 7–8. *pp.* 566–575, 1930.

Material waves defined as thin sheets of electric field [see Abstract 1881 (1930)] are shown to be unpolarisable, in agreement with experiment. It is found, however, that all the well-known types of polarisation of light can be explained in terms of the suggested " tube of force theory " of the light quant, assuming a ray of light to consist of a chain of dipole light quants with their axes perpendicular to the direction of propagation, adjacent dipoles having parallel or nearly parallel axes. The course of events when a tube of force or dipole light quant meets an electron or an atom is examined. Photoelectric emission will occur only if both electron and proton come within the " tube of force," and provided the energy of the light quant is adequate. It is deduced that for hydrogen in the ground state the photoelectrically active range of the spectrum lies between 0·47 and 915 Å. The possibility of a pseudo-photoelectric effect, a kind of intense Compton effect, is also envisaged. W. S. S.

3105. Orientation of Anisotropic Particles in an Electric Field. C. E. Marshall. *Faraday Soc., Trans.* 26. *pp.* 173–189, *April*, 1930.

It is shown that a certain discrepancy exists between the views of the French physicists and the German colloid chemists concerning the nature of the orientation of suspended particles by the electric field. With a comparatively simple apparatus for measuring the double refraction of sols, it is demonstrated that in accordance with the views of the French physicists, the orientation of anisotropic particles depends primarily on their fundamental electrical properties. Substances obeying Maxwell's rule give a + double refraction with respect to the lines of force, whilst those not obeying it give a − double refraction. In favourable cases the electrical double refraction approaches the true double refraction of the solid. On applying the method to clays, it is shown that these are essentially crystalline, however small the particles may be, and that the value of the double refraction can, under suitable conditions, be taken as a characteristic constant for a clay fraction saturated with a particular kation. A study of the variation in double refraction with the kation leads to the conclusion that the exchangeable kations take up definite positions in the crystal lattice. Base exchange equilibria can be investigated similarly. Finally, clays are shown to exhibit the phenomenon of orientated coagulation in a manner which suggests that when saturated with different kations they have, in general, characteristic degrees of dispersion. This subject is being pursued further. AUTHOR.

3106. Optical Rotation of Cellulosic Materials. Part I. Soluble Cellulose in Alkali. T. F. Murray, Jr., C. J. Staud and H. le B. Gray. *Am. Chem. Soc., J.* 52. *pp.* 1508–1519, *April*, 1930.

A study of the optical rotation of the alkali soluble portion of cellulose to assist in the determination of the nature of the material dissolved and possibly the cellulose degradation. Hydrocelluloses were prepared by the action of phosphoric, sulphuric and hydrochloric acids and the specific rotations of the acid filtrates determined. The activity of the acid solutions indicated by the material dissolved and fibre breakdown increased in the order orthophosphoric, sulphuric, and hydrochloric acids. The acid filtrates were all dextrorotatory, indicating possibly dextrose. The alkaline extracts varied from 2·5 % for the phosphoric to 48 % for the hydrochloric acid hydrocellulose. All were laevorotatory, confirming the work of Hess and others on regenerated cellulose. The hydrocelluloses were extracted with 17·5 % NaOH, and the specific rotations determined. Long fibre cotton has been oxidised with potassium dichromate and potassium permanganate, extracted with 17·5 % NaOH solution and the optical rotations measured. Photomicrographs showing fibre breakdown are given. S. G. B.

3107. Magneto-Rotatory Behaviour of Some Optically Active Substances in Solution. S. S. Bhatnagar, K. N. Mathur and B. D. Jain. *Indian Journ. Phys.* 4. *pp.* 503–513, *April* 30, 1930.

The results obtained with a number of substances show that, for any particular solvent the current, and hence the magnetic field, required just to balance the optical rotation is proportional to the optical rotation itself: $H = K\theta$, the value of K for optically active solutions of solids being constant for each solvent. Unlike optical rotation, the magnetic rotation of an optically active solution of a solid is independent of the concentration within the range studied. With solutions of optically active liquids in inactive liquids, where high concentrations of the optically active substance could be used, the magnetic rotation does change with the concentration and seems to depend on the volume concentration of each of the liquids. If, for a certain magnetising current, θ_1 and θ_2 are the magnetic rotations for purely inactive solvent and purely active solute respectively, the magnetic rotation for a particular wave-length at any intermediate concentration taken as a percentage of the total volume is given by $\delta_n = \theta_1 + \frac{\theta_2 - \theta_1}{100} C_n$, where C_n is the concentration of the solution in c.c. per cent. T. H. P.

3108. New Method of Alignment. J. Bonnaffé. *Rev. d'Optique,* 9. *pp.* 17–34, *Jan.*, 1930.

The author discusses old methods of alignment in which a source of light is employed and successive points are found by means of screens. Many errors are introduced and the play of a lens carrier in a telescope may cause large errors. In the method proposed a small astronomical telescope is used, the objective having a convenient diaphragm. A collimator placed at the other end of the line to be tested causes variations in the brightness of the image of the circular diaphragm, these variations being produced by the interposition of a screen with a slit between the collimator and telescope. Particular attention is paid to the instant when the movable screen just extinguishes the last diffraction ring around the central spot. It is claimed for the new method, in use in ship construction at Brest, that the errors are reduced to one-tenth, it is quicker and more reliable, and no difficulties occur in practice. R. S. R.

3109. Relativity Principle of Classical Optics. O. Heimstädt. *Zeits. f. Physik,* 61. 9–10. *pp.* 667–674, 1930.

On the basis of the wave theory for a carrier at rest light scattering effects of the first magnitude could not occur for angular measurements. If the incorrect assumptions of classical optics are accepted then, for certain experimental arrangements, effects of this magnitude arising from differences of light path on account of the earth movement should be demonstrable. Experimental arrangements are shown to illustrate this. Using a known shift of the wave front, occurring according to the assumptions of classical optics for moving optical systems and mirrors, it is shown that the relativity principle of classical optics regarding the constancy of angle size is closely true. Further, a constancy of light path in reference to magnitudes of the first order of β, the aberration constant, occurs only in special cases where the light, by reflection, retraces its original path. With normal methods the image displacement, βf, which occurs for systems of long focal length, must be established according to classical optics.

R. S. R.

3110. Astigmatism of the Beam Refracted by a Spherical Dioptric Surface. M. Dufour. *Comptes Rendus*, 190. *pp.* 1008–1010, *April* 28, 1930.

Employs what is known in Germany as the Weierstrass construction, and finds, for a narrow beam starting from a point which is not on the axis, the beam being inclined to the axis, the stigmatic points of the dioptric system, the focal points and the distance between them and the astigmatism of the refracted beam by a purely geometrical method.

H. N. A.

3111. Astigmatism in Mirror Spectrometers. M. Czerny and A. F. Turner. *Zeits. f. Physik*, 61. 11–12. *pp.* 792–797, 1930.

It is possible that in mirror spectrometers the errors produced by the first mirror in the course of the rays may be increased by the second mirror. If, however, this is placed to reflect the rays to the other side the errors will be partly compensated, and an image of the slit formed which will be satisfactory for practical purposes. This is not really new, but has often been lost sight of recently, and the authors have carried out a simple test with two concave mirrors and a slit to show the difference between the correct and incorrect arrangements. H. N. A.

3112. Angles of Floating Lenses. C. G. Lyons. *Chem. Soc., J. pp.* 623–634, *April*, 1930.

The shapes and angles of liquid lenses floating on the surface of a different liquid have been studied by a photomicrographic method. The angles are subject to wide variations, and are especially sensitive to alterations in the interfacial tension between the two liquids. It has been shown, further, that these angles differ from those calculated on the basis of Neumann's triangle, and the causes of the difference have been investigated. The contact angles at a junction of three liquids have been investigated with reference to the theory of emulsification. It has been suggested that emulsification by soap may be determined by the existence of a bimolecular soap leaflet at the oil-water interface. H. H. Ho.

3113. Poivilliers' Differential Refractometer. *Rev. d'Optique*, 9. *pp.* 78–81. *Feb.*, 1930.

Particulars are given of the form of apparatus and method of operation by which an accurate and rapid measurement can be made of the difference of refractive index for two liquids when only small amounts are available. Upon two faces of the prismatic block are placed respectively one drop of the liquid to be tested and one drop of a liquid of known refractive index. The image is obtained by total reflection and displaced by a deviating arrangement. The refractive index, obtained from a table, depends upon the position of the deviator. The method requires a known liquid possessing sensibly the same variation of refractive index with temperature as the liquid to be tested, and in this way is simpler than to work with the modified Pulfrich refractometer. The apparatus was devised for blood tests to obtain information relating to the progress of certain diseases, but it can also be used to test the purity of products, concentration of solutions, etc. R. S. R.

3114. Calibration of Refractometers. R. Richter. *Zeits. f. Instrumentenk.* 4. *pp.* 254–256, *April,* 1930.

Briefly describes the usual method of calibration of refractometers, indicating materials which are most used for this purpose. A new means of obtaining this calibration, using testing prisms instead of parallel-sided materials, is briefly described and the theory examined. R. C. F.

3115. Determination of the Inner Orientation of the Chamber of a Phototheodolite. P. Werkmeister. *Zeits. f. Instrumentenk.* 4. *pp.* 246–254, *April,* 1930.

Mathematically obtains the solution to the problem of the inner orientation of a phototheodolite in a slightly different form from that obtained by Baeschlin. The accuracy of the formulæ is examined for a specific case of a Zeiss phototheodolite. R. C. F.

3116. Interference Method for Measuring Indices of Refraction of Solutions. C. Bortolotti. *N. Cimento,* 7. *pp.* 148–152, *April,* 1930.

The object is to produce an arrangement capable of dealing with small differences in refractive index due to slight changes in concentration. The interferometer uses white light fringes obtained with a biprism, giving a spectrum crossed by black lines of which the spacing broadens with the wave-length. Using a prism spectroscope, the fringes are not straight owing to the irrationality of dispersion, but their curvature varies with the refractive index. Pure water is placed in the path of one of the interfering beams, and the solution in the other. The equality of these two vessels is of the greatest importance. The theory is worked out, and it is shown that the difference in refractive index may be measured in terms of observable quantities. Photographs are given showing the fringes with pure water and with sodium chloride solutions of ½ to 2½% concentration. J. H. A.

3117. Photography of Fabry and Perot Interferometer Fringes by Using a Simple Optical System. S. E. Green. *Phys. Soc., Proc.* 42. *pp.* 153–155; *Disc.,* 155–156, *April* 15, 1930.

A simple method of photographing Fabry and Perot interferometer fringes is outlined, and some examples of the results obtained with mercury radiation are given. AUTHOR.

3118. Photographic Self-Timers. K. N. Mathur and T. K. Lahiri. *Journ. Sci. Instruments,* 7. *pp.* 122–125, *April,* 1930.

The performance of photographic self-timers has been investigated by means of a vibration galvanometer worked by an electric tuning fork. It has been found that the self-timers are quite reliable instruments in that exposures can be repeated with good accuracy, but no reliance whatsoever can be put on the readings indicated on the dial, which may be very much in error. AUTHORS.

3119. Blackening of Photographic Plates by Electronic Radiation. M. J. Nacken. *Phys. Zeits.* 31. *pp.* 296–306, *April* 1, 1930.

Examines the blackening of photographic plates produced by electronic radiation obtained in a special type of hot-kathode tube, the construction of which is described. The Roscoe-Bunsen law is shown to be valid, within the limits of experimental error, from measurements of the relation between blackening and exposure time at constant electron intensity, and that between the blackening and intensity for equal exposure times, electrons with a velocity of 1500 volts being used for these measurements. The solarisation phenomenon for exposures made with electronic radiation apparently only occurs under particular conditions, whilst it is also possible to make the exposure so small that the blackening cannot be distinguished from development fog. Blackening curves taken with electron velocities of 700, 3700, 5520 and 8700 volts at first show a very slow increase and then a very rapid rise. With very low blackening values the curves bend down, the blackening remaining approximately constant over a certain region, the blackening value at which this occurs being lower the higher the electron velocity. The blackening curves obtained are the combination of two families of curves, those which increase to the region of constant blackening and those for long exposure times. The blackening for the former curves is connected with the depth of penetration of the electrons. R. C. F.

3120. Physical Photometry. J. Thovert. *J. de Physique et le Radium*, 1. *pp.* 121–125, *April*, 1930.

The possibility of precise spectrophotometric measurements, using the photoelectric cell, makes the obtaining of physical definitions of the luminous qualities of light sources very desirable. It is shown that the choice of an arbitrary function of visibility allows of the monochromatic luminosity and its relative value corresponding to its colour to be defined. Further, an apparatus is briefly described which, with improvements in manufacture of the photoelectric cell, can be used for rapid measurements using the definitions given. R. C. F.

3121. Excitation of Phosphorescence Bands at Various Temperatures. F. Schmidt. *Ann. d. Physik*, 4. 8. *pp.* 1127–1136, *April* 28, 1930.

The apparatus for observing phosphorescence bands excited by equal energy at all wave-lengths is described. Observation is made with a thermopile and variations of intensity and positions of maxima may be traced. Several previously unknown maxima of BaSCu α- and CaSMn α-bands have been found. F. S.

3122. Absorption Spectra of Salt Solutions. (Miss) S. Kato. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 233. *pp.* 7–21, *March* 30, *and No.* 235. *pp.* 49–58, *April* 14, 1930. *In English.*

This is a continuation of previous work [see Abstract 2524 (1930)]. The first paper deals with oxyacidic salts, the anions being divided into two groups. The first group contains those with general absorption on the more refrangible side, the absorption edges being shifted to longer wave-lengths when the acid radicle is reduced to less valency. For the second group the reverse holds good. Various deductions are made con-

cerning stability. The second paper is concerned with the kations, the selective absorption being attributed to change of electron spin in the outermost *d*-shells. The effect of surrounding atoms and molecules is discussed, and it is noted that the more stable ions have smaller selective frequencies.
F. S.

3123. Extinction Coefficients of Mixtures of Chromates and Dichromates. N. R. Tawde and G. R. Paranjpe. *Indian Journ. Phys.* 4. *pp.* 533–538, *April* 30, 1930.

The measurement of the extinction coefficients of the mixtures of chromates and dichromates is described in this paper. The results obtained have been utilised to estimate the percentage of chromate and dichromate in presence of each other. AUTHORS.

3124. Ultra-Violet Absorption of Inorganic Salt Solutions. Part II. Absorption of Alkaline Earth Halides. J. v. Koczkás. *Zeits. f. Physik*, 61. 7–8. *pp.* 545–547, 1930.

The intensity of the ultra-violet absorption increases in the order Ca → Sr → Ba, and Cl → Br → I. [See also Abstract 2159 (1930).]
A. C. M.

3125. Near Infra-Red Absorption Spectrum of Calcite. J. W. Ellis. *Nat. Acad. Sci., Proc.* 16. *pp.* 315–320, *April*, 1930.

A new investigation using thicker sections of calcite gave in the near infra-red absorption spectrum of calcite ($\lambda < 3\ \mu$), three new bands with wave-length shorter than $1 \cdot 7\ \mu$, doublet structure in practically all the bands in the near infra-red, almost complete disappearance of all the bands when the light is nearly completely polarised at right angles to the optic axis, an increase with amplitude in the force coefficient associated with one of the four independent modes of vibration of the carbonate ion. The results are discussed in the light of the accepted theory that the near infra-red bands are due to the vibrations of the CO_3 ion. The results indicate that all the bands below $3\ \mu$ are combinations or overtones of the three frequencies associated with vibrations of the plane carbonate ion, in its own plane, and a table is given showing how each observed band arises in this way. No observed band is left unaccounted for. W. S. S.

3126. New Cause to Increase or Modify Intensity of Rays and Bands in Spectra of Atoms and Molecules. H. Deslandres. *Comptes Rendus*, 190. *pp.* 836–840, *April* 7, 1930.

The author refers to earlier work on spectra of simple chemical bodies and their hydrogen components in which it was shown that the most brilliant parts were with slight differences multiples of the same infra-red frequency 1062·5. This was later found to hold for other substances whose atomic weights were simple multiples of that for He. It was considered due to internal vibrations of the proton. Solar spectra in 1929 during the total eclipse indicate the action of atoms or He nuclei, and even H, on radiations in their vicinity. In the chromosphere the maxima of intensity occur very nearly at multiples of 1062·5. This is shown for three doublets of Ti, Cr and Fe, and in a table examples are shown for other elements. It is greater in 1905, a year of maximum sunspots, than 1926, a year between maximum and minimum. In the spectra of the aurora borealis and from the bands in the comet's tail the most brilliant bands have very nearly the same multiple of this infra-red frequency, and the same atomic weight. Further data are to be given. R. S. R.

3127. Hydrogen and Helium Lines as Standards of Wave-Length. W. G. Penney. *Phil. Mag.* 9. *pp.* 661–664, *April*, 1930.

As it is impossible at present to resolve spectroscopically the fine structure of the Lyman lines it must be assumed that the position of the line observed refers to the centre of gravity of the components. Using the theoretical values of the frequencies and relative intensities of the components, the centre of gravity is computed for the first three lines in the Lyman series, the first six lines in the Balmer series and the corresponding lines in the spectrum of helium. Comparing with experiment, except in the case of the Balmer lines of hydrogen, the observational accuracy is insufficient to show if the correction for fine structure improves the agreement. W. S. S.

3128. Combination Series of Helium. Y. Ishida and T. Tamura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 241. *pp.* 115–134, *April* 28, 1930. *In English.*

The wave-lengths of forbidden lines emitted by helium in strong electric fields are measured and tabulated against calculated values, corresponding combination, azimuthal quantum transition, polarisation and voltage at which the line appears. The dependence of "critical voltage of appearance of combination lines" on total and azimuthal quantum numbers is investigated. The series limits calculated from the observed data are compared with those of Paschen; and tables of the combination series are given. C. B. A.

3129. Band Spectra of Alkali Vapours. W. Weizel and M. Kulp. *Ann. d. Physik*, 4. 7. *pp.* 971–984, *April* 15, 1930.

Walter and Barratt's results [see Abstract 2711 (1928)] for the vapours of Na_2, K_2, NaK, NaCs, LiK, LiKb, LiCs and NaRb are considered and the band heads arranged. Term schemes are given for the ground and upper terms. F. S.

3130. Isotope Effect in Lithium Absorption Bands. A. Harvey and F. A. Jenkins. *Phys. Rev.* 35. *pp.* 789–801, *April* 1, 1930.

The analysis of the blue-green Li_2 bands previously given by Wurm is extended by new data obtained with second-order plates from a 15-ft. grating, and lines of the (0, 1) band are tabulated. The vibrational isotope effect is established by the identification of three band heads, (1, 0), (2, 0) and (3, 0), due to the less abundant isotopic molecule Li^6Li^7, which were found in their calculated positions. The rotational isotope effect in the (0, 0) band is shown by the detection of two faint-line series fitting closely the theoretical equations for the Q and P branches due to Li^6Li^7. The alternation ratio of intensities of successive lines in the Li^7_2 bands is determined by a new method, the best value found from the Q branches of the (0, 0) and (1, 0) bands being $1 \cdot 78 \pm 0 \cdot 2$. The isotope lines due to Li^6Li^7 show no alternation in accordance with theory. F. S.

3131. Spectrum of Bromine in Different Stages of Ionisation. S. C. Deb. *Roy. Soc., Proc.* 127. *pp.* 197–217, *April* 1, 1930.

The data given by L. and E. Bloch and in Kayser's *Handbuch* has been used to classify the lines in different stages of ionisation. Additional data have been obtained using a tube described by Majumdar and a plane grating and glass lens. The ionisation potentials of Br^+ and Br^{++} are placed at about 19·1 and 25·7 volts respectively. The utility of the extension of the irregular doublet law and the horizontal comparison method of Saha and Majumdar is shown in the classification. F. S.

3132. Intensity Measurements in the Arc Spectrum of Thallium. O. U. Vonwiller. *Phys. Rev.* 35. *pp.* 802–808, *April* 1, 1930.

Measurements were made by the photographic method of the ratio of intensities of the lines $2p_2 - 2s$, $2p_1 - 2s$ in the arc spectrum with a current of 1·6 A. using alloys of lead and thallium in varying proportions. The ratio increased with decreasing concentration of thallium, reaching a limit at about 0·01 %, the effects of absorption being negligible at this stage. Measurements for members of the principal series $2s - mp_1$ and $2s - mp_2$ were also made for $m = 4$, 5, 6 and 7, the values being found to be independent of thallium concentration and of current in a restricted range of tests. F. S.

3133. Band Spectrum of Silver Chloride. B. A. Brice. *Phys. Rev.* 35. *pp.* 960–972, *April* 15, 1930.

The electronic band system of AgCl extending from λ3124 to λ3400 has been obtained in emission and absorption, the latter under high dispersion, and a complete vibrational quantum analysis has been carried out. The vibrational isotope effect was observed for both the Cl and Ag atoms. The complete spectrum consists of four overlapping systems due to the four possible isotopic molecules. The heats of dissociation of the AgCl molecule are $D_0' = 3 \cdot 11$ volts in the normal state, $D_0'' = 0 \cdot 31$ volt in the excited state. The energy of excitation of the atoms resulting by dissociation from the excited state is 1·10 ± 0·12 volt. F. S.

3134. Relation between Intensity and Position of Overtones of Some Organic Liquids. P. E. Shearin. *Phys. Rev.* 35. *pp.* 973–976, *April* 15, 1930.

A theoretical study of the intensity relations of the overtones of some organic liquids has been made with a view of determining whether there exists a relation between the intensity and position of overtones. A brief summary of some of the work that has been done by other observers is included. By the graphical method the intensities of the first and second overtones of some liquids were measured. These results, together with the ratio of the intensities of the first and second overtones, and also a list of the products of this ratio times the correction factor x, are given in a table. Values are also listed for three diatomic gases, the intensities having been obtained by other observers and the ratio of these intensities times the correction factor being calculated in this work. For both the liquids and the gases the product of the ratio of the intensities of the first and second overtones and the correction factor x is of the same order of magnitude and, in consideration of the errors involved, appears to be constant. AUTHOR.

3135. Change of Wave-Length and Intensity in Iron Lines by Disruptive Discharge. H. Nagaoka, T. Futagami and I. Machida. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 146–149, *April,* 1930. *In English.*

Conditions approximating to those of a stellar atmosphere can be obtained on a minute scale over an interval of microseconds by the electric explosion of thin wires. The spectrum thus produced is compared with the normal arc spectrum and the arc lines present show shifts. Some lines are reversed and the intensities are much affected. C. B. A.

3136. Band Spectrum of Ionised Mercury Hydride. T. Hori. *Zeits. f. Physik*, 61. 7–8. *pp.* 481–489, 1930. *Ryojun Coll. Eng., Mem.* 2. 4*d. pp.* 305–314, *March*, 1930. *In German.*

Bands between 2500 and 2200 Å. in the spectrum of mercury hydride, investigated by Jezewśki, are attributed to an ionised molecule of mercury hydride. The transition type is $^1\Sigma \rightarrow {}^1\Sigma$, and the molecular constants relating to each of these $^1\Sigma$ states are calculated. The ionisation energy of the neutral HgH molecule corresponds with that of the corresponding gold atom. The $^2D^1_{5/2}$ term of the Hg^+ spectrum originates owing to dissociation occurring in the $^1\Sigma$ state. J. S. G. T.

3137. Double Series of Rotational Terms in Singlet Σ Terms. W. Weizel. *Zeits. f. Physik*, 61. 9–10. *pp.* 602–603, 1930.

In some cases a Σ- and a Σ′-term can have the same electronic energy. Through the addition of rotational energy, both terms can give rise to two sets of rotational terms analogous to the A and B sub-levels of the Π and Δ terms. An application of this may help to explain the satellites of the OH bands. A. C. M.

3138. Molecular Predissociation Spectra. G. Herzberg. *Zeits. f. Physik*, 61. 9–10. *pp.* 604–614, 1930.

Diffuse molecular spectra, attributed by Henri to predissociation of the molecules, have been explained by Born and Franck [see Abstract 1323 (1925)] as due to a dissociation of the molecule in an excited state in which its time of stay is less than the rotational period. In terms of quantum mechanics, if a system has discrete energy-levels, and also a continuous succession of states, a transition from discrete to continuous occurs with a given probability. The predissociation observed in S_2, in the methyl halides, and in a number of polyatomic molecules is discussed. Franck pictures a transition from the ground electronic state to a second state, with the possibility of transition (non-radiating) to a third electronic state. In the present paper it is pointed out that it is not necessary to assume that this third state cannot combine with the ground state. On the contrary, such combination manifests itself as a continuous spectrum in another spectral region. A. C. M.

3139. Conservation of Rotational Impulse in Photo Emission Phenomena. R. Frisch. *Zeits. f. Physik*, 61. 9–10. *pp.* 626–631, 1930.

The assumption that an emitted light quantum carries with it the difference between the rotational impulses of the atom, before and after emission takes place, has been tested experimentally and found to be incorrect. Gives a possible explanation of this apparent contradiction of the law of the conservation of rotational impulse. H. N. A.

3140. Widening of Spectral Lines by Coupling. Lucy Schütz-Mensing. *Zeits. f. Physik*, 61. 9–10. *pp.* 655–659, 1930.

Frenkel's theory is discussed to higher precision and it is shown that the widening is proportional to the density and not to the square root of it as he found. F. S.

3141. Fermi's Intensity Formula for Alkali Doublets. S. Sambursky. *Zeits. f. Physik*, 61. 9–10. *pp.* 660–662, 1930.

Fermi's formula for the doublets of the principal series of the alkali metals is compared with the author's experimental values. F. S.

3142. Variation in Relative Intensities of Components of Rotation Doublets in the Resonance Spectrum of Sulphur. P. Swings. *Comptes Rendus*, 190. *pp*. 965–967, *April* 23, 1930.

The question has been studied further, and it has been found that the variation takes place in a similar manner for all the terms of a series, but that no such variation takes place in some of the series. Several examples are described, and the possibility that the phenomenon is due to reabsorption by the sulphur vapour is considered. This is on the face of it improbable, and an experiment in which the light was made to pass through a second vessel containing sulphur vapour, the pressure of which was varied, showed that absorption in this second vessel, in which the sulphur molecules were not excited by the mercury arc, in no case altered the relative intensities of the doublets. [See also following Abstract.]

H. N. A.

3143. Resonance Spectrum of Sulphur Vapour. P. Swings. *Zeits. f. Physik*, 61. 9–10. *pp*. 681–700, 1930. *Comptes Rendus*, 190. *pp*. 1010–1011, *April* 28, 1930.

Contains further details of the author's work on the subject, with tables giving the values of ν, λ, $\Delta\nu$, frequency differences and intensities for the doublet series A, B, C and D, and tables for the different multiplet series. It appears that to obtain a satisfactory explanation of the complicated structure of the resonance terms it is not necessary to assume compounded mechanisms, or a complicated structure for the S_2 molecule. Doublet series A, B and C have the distance between the doublet components about $\Delta\nu = 16$ cm.$^{-1}$; these correspond to the rotational quantum number $m = 2$ for the excited molecule S_2. In series D, $\Delta\nu = 33$ cm.$^{-1}$ and the rotational quantum number is $m = 4$. [See also Abstract 2201 (1930) and preceding Abstract.] H. N. A.

3144. Polarisation of Raman Lines from Crystals. M. Leontowitsch. *Zeits. f. Physik*, 61. 7–8. *pp*. 548–556, 1930.

Raman lines differ from one another in respect of their state of polarisation. The polarisation of the lines scattered by quartz and calcite have been studied by Cabannes [see Abstract 1858 (1929)] and by Menzies [see Abstract 1039 (1930)]. The author compares these results with those deduced from the theory previously outlined [see Abstract 2550 (1930)]. It is concluded that the theoretical treatment is only sufficiently thorough to account for the polarisation of some of the lines, which happen to be among the strongest ones. Certain types of polarisation can only be accounted for by assuming that the direction of vibration in the scattered light depends not only on the direction of the electric vector of the incident light, but also on the direction of the wave-normal. A. C. M.

3145. Raman Spectra of Nitrogen and Oxygen. F. Rasetti. *Zeits. f. Physik*, 61. 9–10. *pp*. 598–601, 1930.

The Raman spectra produced by rotational energy changes in the molecules of these two gases are photographed under large dispersion (3 Å. per mm.). In molecules whose normal state is a Σ-state, the rotational quantum numbers change by 0 or ± 2 to produce a Raman shift. Thus every Raman line is due to a combination between odd or even rotational states. If the molecule has two equal nuclei, the odd and even rotational states belong to two separate systems, practically independent. If the nuclei have no moment, only one system (odd or even) exists. If the nuclei have a moment, then both systems exist, but with unequal statistical weights. In the case of oxygen, only the odd rotational states are present, so that the oxygen nuclei obey the Bose statistics. In nitrogen, both even and odd systems are present; but the even rotational states give rise to the strong lines, the odd rotational states to the weak lines. A. C. M.

3146. Intensities of Raman Lines in CCl_4. L. S. Ornstein and J. Rekveld. *Zeits. f. Physik*, 61. 9–10. *pp.* 593–597, 1930.

In the scattering of light by a transparent medium it is well known that the intensities of the unmodified lines are proportional to the fourth power of the frequencies. It is shown that this law holds also for the modified lines, in the case of those produced in CCl_4, both Stokes and anti-Stokes lines. The shifts are not sufficiently great to distinguish between $I \infty \nu^4$ and $I \propto (\nu \pm \nu_i)^4$, where ν is the frequency of the exciting line and ν_i is the frequency-shift. A. C. M.

3147. Electronic Raman Effect. A. Carrelli. *Zeits. f. Physik*, 61. 9–10. *pp.* 632–639, 1930.

So far the change in frequency producing the Raman effect has been due to alterations in rotational, vibrational or rotational-vibrational states. An electronic Raman effect, on the other hand, would depend on a frequency in the electronic spectrum of the atom, that is, on an electron jump. It is shown that though theoretically the Raman effect due to this cause should be observable, it is in general masked by the fact that in the spectral region, where otherwise it might be found, there are zones with strong absorption due to the molecular bands. Conditions are easier in the X-ray region, and this case is treated theoretically by the author. The mathematical methods already employed for the Compton effect can be employed, and the author concludes that it should be possible to observe the effect under the following conditions: the substance must have absorption lines in the X-ray region; its atomic number must be small; the radiations employed must excite Compton electrons which have small recoil energy as compared with the energy of combination; the direction of observation must be such that the recoil energy is not too large. H. N. A.

3148. Zeeman Effect of Hyperfine Structure. F. Stark. *Phys. Zeits.* 31. *p.* 374, *April* 15, 1930.

Deals with the case where the magnetic field is weak with regard to the i (nuclear impulse moment) and j coupling; i and j compound to the quantum vector f. Finds the following formula for the Landé separation factor $g = 1 + \frac{f(f+1) + i(i+1) - j - (j+1)}{2f(f+1)}$. H. N. A.

3149. Zeeman Effect of the Lines of the Neon Isotope Ne^{22}. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 143–145, *April*, 1930. *In English.*

The Zeeman effects of the red and yellow lines of Ne^{22} are measured by means of a Fabry-Perot interferometer to confirm that they are separated in the same manner as the lines of Ne^{20}. [See Abstract 3571 (1929).] C. B. A.

3150. Stark Displacements in Oxygen. S. Doi. *Phys. Math. Soc., Japan, Proc.* 12. *pp.* 75–79, *April*, 1930. *In English.*

The Stark shifts are theoretically calculated and are tabulated for the group of lines $2p - 5q$. In three cases, $2p - 5d$, $- 5s$, $- 5g$, the results agree fairly well with the experimental results of Kiuti, Ochiai and Nishimura. F. S.

3151. Interaction of Stark Effect and Electron Spin in Alkali Atoms. V. Rojansky. *Phys. Rev.* 35. *pp.* 782–788, *April* 1, 1930.

The Stark effect in alkali metal atoms in weak fields is, on the basis of both theory and experiment, a second order effect. It is shown here on the basis of the quantum mechanics that when the second order Stark effect is large enough to be comparable with the multiplet structure, there appears, due to the interaction of the Stark effect and spin, an effect which, in its influence on the multiplet structure, is not unlike the Paschen-Back effect in the magnetic case. It causes a distortion of the multiplet structure and a redistribution of the intensities of the spectral lines. AUTHOR.

3152. Theory of Quadratic Stark Effect in Doublets and Triplets. A. Wolf. *Zeits. f. Physik*, 61. 9–10. *pp.* 619–625, 1930.

The fine structure of regular doublets and triplets in strong electrical fields is deduced from the Pauli-Darwin equations. It is found that when a sufficiently strong field is assumed the Stark effect is essentially made up of two parts, the first being a shift proportional to the square of the field, and the second, which results from the spin of the electrons, consisting of a fine structure which is superimposed on the above shift, and in the limit is independent of the field. This is illustrated by means of two graphs for a doublet and a triplet p-term. H. N. A.

3153. Strongly Excited Atoms in Electric Fields. H. Kuhn. *Zeits. f. Physik*, 61. 11–12. *pp.* 805–815, 1930.

Changes are observed which are undergone by the limit of the series lines of potassium in absorption, under fields of 100 to 300 volts per cm. Characteristic differences appear between the π and σ components in the matter of dropping out of higher terms; these can be explained in terms of directional quantising and orbital angular momentum. In the light vibrating perpendicularly to the field appear lines of the "forbidden" series $1S$–nD. The extinction is greater than one would expect theoretically. This is attributed to the intervention of ionic fields. A. C. M.

3154. X-Ray Optics. W. L. Bragg. *Phot. J.* 70. *pp.* 179–186; *Disc.*, 187, *April*, 1930.

Essentially as lecture with same title [see Abstract 2753 (1929)]. W. V. M.

3155. Automatic Control of the Vacuum in a Shearer X-Ray Tube. T. N. White. *Journ. Sci. Instruments*, 7. *pp.* 99–100, *March*, 1930.

The efficiency and life of a Shearer X-ray tube depend largely on the maintenance of the correct pressure of gas within it. The by-pass and pinch-cock method of control requires considerable attention. The device herein described enables the conditions to be kept constant automatically within a few per cent. and for an indefinite period. AUTHOR.

3156. X-Ray Camera. C. Leiss. *Zeits. f. Physik*, 61. 9–10. *pp.* 663–666, 1930.

Describes a camera suitable for taking X-ray powder and fibre photographs. W. H. GE.

3157. X-Ray Apparatus for Investigation of Microscopic Crystals. O. Kratky. *Zeits. f. Krist.* 73. 5–6. *pp.* 567–570, *April;* 1930.

The essential part of the apparatus is the "stop" through which the pencil of X-rays passes. The opening nearest the crystal is 0·05 × 0·01 mm., the sides converging to the wider distance diverge at 30°, those to the narrower at 1°, the thickness of the block being about 2 mm. In this way a flat triangular pencil is produced. The crystal is placed 0·10 mm. from the opening, supported on a thin collodion film stretched across projections from the "stop," and the sensitive film is about 2·4 mm. therefrom. The whole apparatus is in a dark room. An example is given of a photograph of a crystal of gypsum 0·02 mm. in diam., taken with a current of 10 mA and 35 kV with exposure of 5 hours. C. A. S.

3158. Angular Intensity Distribution of Continuous X-Ray Spectrum. Part II. Y. Sugiura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 234. *pp.* 23–47, *April* 10, 1930. *In English.*

In the previous work on this subject [see Abstract 1480 (1930)] the retarded coordinate matrix elements were used to compute the angular intensity distribution. It appears, however, that when the retardation factor is introduced it is necessary to employ the current matrix elements instead of the coordinate matrices. The calculations of the angular intensity distribution are repeated in the present paper using the retarded current matrix elements. The chief points of difference between the results of the present and former calculations are (1) the intensity in the directions $\theta = 0°$ and $\theta = 180°$ is *now* found to have a non-zero value; (2) the variation of polarisation of the emitted X-rays with the angle θ follows entirely different curves in the two cases, the present work indicating directions of zero polarisation near $\theta = 0°$ and $\theta = 180°$. W. S. S.

3159. L Series Spectra of Elements from Calcium to Zinc. C. E. Howe. *Phys. Rev.* 35. *pp.* 717–725, *April* 1, 1930.

Using the first inside order of a plane grating (600 lines per mm.) L lines of the elements Zn, Cu, Ni, Co, Fe, Mn, Cr, V, Ti and Ca have been measured. Separation of the L_a and L_β lines, as well as the L_l and L_η, is attained by adjusting the grating so that the angle between the inside order and the plane of the grating is small. Under this condition the angular dispersion is given by $(da/d\lambda) = (1/D\beta)$, where D is the grating space and β the small angle between the plane of the grating and the first inside order. The results obtained are somewhat higher than those obtained by crystal measurements, but are entirely consistent with the work of other experimenters. The failure of the L_a and the L_β lines to appear in the case of calcium is in accord with Foote's extension of Stoner's arrangement of the electrons. All measurements are absolute.
AUTHOR.

3160. Correction Factors in Photographic Measurement of Integrated Intensities of X-Ray Reflection. E. G. Cox and W. F. B. Shaw. *Roy. Soc., Proc.* 127. *pp.* 71–88, *April* 1, 1930.

Deals especially with X-ray single crystal rotation photographs. A geometrical correction factor is calculated to be applied to measurements when the reflecting crystal planes do not contain the axis of rotation of the crystal. The factor allows for the decrease in speed of angular velocity and the consequent increase in relative time of exposure for such planes. A film absorption factor takes into account the differing angles of incidence of beams striking the film or plate at different points. Theory and experimental confirmations are given, together with two transparent charts by which the values of the correction factors may be read off from an enlargement of the photograph. The ordinary polarisation factor $\frac{1}{2}(1 + \cos^2 2\theta)$ is also examined critically and is found to be valid in practice. W. H. GE.

3161. Intensity Measurements of X-Rays Reflected from Deformed Lattices. J. Hengstenberg and H. Mark. *Zeits. f. Physik*, 61. 7–8. *pp.* 435–453, 1930.

The validity of intensity measurements as a means of indicating the extent of small structural changes in lattices due to mechanical, chemical, thermal and electrical agencies is considered. Using an ionisation spectrometer, the intensity has been studied in its relation to the extent of plastic deformation. For the lower orders (200) and (400) marked increases in the intensity were observed which are ascribed to the occurrence of slip. At higher orders (600), (800) and (1000) there is a decrease in intensity. It is suggested that this is due to a deformation of the lattice, and it is pointed out in support that these changes can be eliminated by sintering. Further, evidence is brought forward that these changes are confined to the region of the slip planes. F. J. W.

3162. Intensity Measurements of Diffuse X-Rays from a Deformed KCl Crystal. R. Brill. *Zeits. f. Physik*, 61. 7–8. *pp.* 454–457, 1930.

Apparatus for the measurement of the intensity of X-rays using a Geiger counter is described. Using this apparatus, it is shown that there is an increase in the intensity of the diffusely scattered X-radiation from a crystal of potassium chloride when the crystal is deformed. F. J. W.

3163. Internal and Superficial Structure of Organic Liquids. J. J. Trillat. *Comptes Rendus*, 190. *pp.* 858–860, *April* 7, 1930.

Organic liquids with long chains (fatty acids, alcohols, triglycerides) were examined by means of X-ray diagrams. The principal halo of diffraction is due to the mean spacing between the molecules and Bragg's formula, $\lambda = 2d \sin \theta$, then gives a measure of this spacing. For the study of the internal structure, the liquid was placed in a hole 1 mm. deep, and for the principal halo of the fatty acids numbers varying between 4·1 and 4·7 Å. were obtained, which correspond well with the mean spacing (or mean thickness) of the molecules determined by other methods. Analogous results were obtained with the other liquids. Besides, there appears in the central region of the diagram an intense blackening of circular form of which the diameter decreases regularly with the number of carbon atoms in the chain. Molecular associations seem to occur forming chains of variable length. For the examination of superficial structure, the method of the tangent drop was used, whose curved surface was struck by a horizontal beam of X-rays. Haloes in the form of a half-circle centred on the middle of the drop due to the mean intermolecular spacing were obtained. In the case of the fatty acids, alcohols and triglycerides, with a number of C atoms between 8 and 14, a band parallel to the free surface of the liquid was observed. The distance from this band to the radiographic projection of the drop varies with the number of C atoms, and on applying Bragg's formula the numbers obtained agree with those got by other methods for the length of the molecules. The diagrams indicate in the neighbourhood of the surface of separation between liquid and air a mean orientation of the molecules which decreases with distance from the free surface. The superficial structure of the liquids appears to be different from the internal structure in consequence of this statistical orientation of the molecules due to the discontinuity of the molecular fields in this region. J. J. S.

3164. Determination of Electron Distributions from Measurements of Scattered X-Rays. A. H. Compton. *Phys. Rev.* 35. *pp.* 925–938, *April* 15, 1930.

A calculation based on clasical electromagnetic theory is made of the intensity of the X-rays scattered by an atom in which the electrons are arranged with random orientation and with arbitrary radial distribution. Conversely, an expression is derived for the radial distribution of the electrons in an atom, assuming that they have random orientation. This expression has the form of a Fourier integral, which can be evaluated from observed intensities of the scattered X-rays for different wavelengths and angles. A comparison of this calculation with Wentzel's quantum theory of X-ray scattering suggests the introduction of a certain correction factor to express more nearly the intensity of the modified rays. It is also noted that the interpretation of $\psi\bar{\psi}$ as a probability of the occurrence of an electron leads to the correct value for the intensity of total scattered X-rays. As an example of the application of the new method of calculation, Barrett's experimental data [see Abstract 2738 (1928)] for the scattering of X-rays by helium are analysed to give the distribution of the electrons in the helium atom. The resulting distribution is in close agreement with the value calculated by Pauling on the basis of wave mechanics, but differs by more than the probable experimental error from the electron orbits given by Bohr's theory. AUTHOR.

3165. Scattering of X-Rays. J. Thibaud and J. J. Trillat. *Zeits. f. Physik,* 61. 11–12. *pp.* 816–836, 1930.

When an X-ray diagram is made by scattering in an organic substance of several mm. thickness, without separating the characteristic radiation from the continuous, a second ring is found besides the chief ring characteristic of the molecules of the scattering substance. With a copper antikathode and liquid fatty acids, the second ring appears in thicknesses greater than 2 mm., and its intensity increases as the thickness increases, while, owing to absorption, the main ring gets weaker. This second ring may be explained as a diffraction effect of the continuous radiation. When the thickness is kept constant and the excitation potential on the X-ray tube is altered, the second ring is diffuse and small at about 40 kV, while it is sharper and larger at about 15 kV. If a molybdenum antikathode is used, the two rings coincide. This phenomenon appears to be general and is observed for many organic substances, liquid and solid, as well as water. The absorption coefficients μ_1 for MoKα, and μ_2 for CuKα have the following values: acetic acid, $\mu_1 = 0 \cdot 73$, $\mu_2 = 7 \cdot 9$; heptyl acid, $\mu_1 = 0 \cdot 65$; nonyl acid, $\mu_1 = 0 \cdot 5$, $\mu_2 = 4 \cdot 5$; molten stearic acid, $\mu_1 = 0 \cdot 5$, $\mu_2 = 3 \cdot 72$. These same absorption coefficients are calculable from the additive values for the elements C, H and O. The origin of the second rings is made clear by obtaining the spectral intensity distribution curves of the continuous X-radiation transmitted through layers of given thickness. This phenomenon provides a likely source of error in the interpretation of X-ray diagrams. A. C. M.

RADIOACTIVITY.

3166. Activity of Radium Emanation. J. Zahradníček. *Zeits. f. Physik*, 61. 9–10. *pp*. 719–724, 1930.

Radium emanation was measured by means of a torsion balance. The new method differs from the earlier arrangements of the ionic wind in that the torsion balance used is completely enclosed in metal and that no condenser and no external electric field are used. The field of force of a radium emanation preparation which is in the neighbourhood of the balance is in such a direction that the balance arm which is nearer to the preparation is attracted. The deflection of the balance from the equilibrium position is directly proportional to the activity of the preparation measured electrometrically and a function of the distance between the preparation and the balance. Some autograms registered photographically of the torsion balance under the action of radium emanation preparations of about 140 and 40 millicurie are reproduced. J. J. S.

3167. Frequency of Occurrence of Disintegrative Synthesis of Oxygen 17 from Nitrogen 14 and Helium. W. D. Harkins and A. E. Schuh. *Phys. Rev.* 35. *pp*. 809–813, *April* 1, 1930.

By the use of a modified Wilson-Shimizu apparatus, 39,000 photographs were taken of the tracks of α-rays in nitrogen. The rays used were those from thorium C and C′ as in earlier work in this laboratory. Two disintegrative syntheses were obtained of oxygen of mass 17 and isotopic number 1 by the attachment of the α-particle in each case to the nucleus of an atom of nitrogen. Evidence is presented which shows that the nitrogen atoms which are acted on in this way are in general those of mass 14 and isotopic number 0. The number of disintegrative syntheses per million α-tracks is 8, while the average of this and all other work gives 15. In this work the ratio of the number of inelastic to elastic collisions was smaller than in any earlier work, but this was due largely to the occurrence of an abnormally high number of elastic collisions.

AUTHORS.

3168. Distribution in Time of Scintillations Produced by α-Particles from a Weak Source. N. Feather. *Phys. Rev.* 35. *pp*. 705–716, *April* 1, 1930.

The course of radioactive transformation, which in all known cases takes place in strict conformity with an exponential law of decay, is most satisfactorily explained on the supposition that individual atoms disintegrate in complete independence of one another, so that the disintegrations throughout an extended source constitute a perfectly random series of events. Many observations favour this conclusion, but recent experiments show that at high concentrations [Kutzner, see Abstract 127 (1928)] and also at very low concentrations [Pokrowski, see Abstract 1491 (1930)] departures may occur. An experiment is here described in which the record of more than 10,000 scintillations produced by the α-particles from a weak source of polonium has been obtained and analysed. A large solid angle was effective, as in Pokrowski's experiments. The various corrections to be applied to the immediate data are discussed; in the present case they were of no importance. There was no evidence to show that the Marsden-Barratt distribution formula was not completely valid under the conditions obtaining. An investigation was also made of the effect of intense γ-radiation on the rate of disintegration in a weak source (Pokrowski), with entirely negative results. AUTHOR.

3169. Absorption of β-Rays. J. A. Chalmers. *Cambridge Phil. Soc., Proc.* 26. *pp.* 252–257, *April,* 1930.

It is found that the processes of loss of velocity and scattering are adequate to give a satisfactory account of the complete absorption curve of β-rays measured by Schonland [see Abstract 1957 (1925)]. It seems very probable that the same explanation can be applied to absorption curves for β-rays of other velocities, and for absorption in other materials. Other processes can therefore only be effective, if at all, to a very small extent. E. E. F. d'A.

3170. Effects of Ionisation by Solar Action. A. Nodon. *Comptes Rendus,* 190. *pp.* 882–884, *April* 7, 1930.

In researches made at the Collège de France in 1902 thin metal plates of zinc, iron, copper, aluminium, and lead were arranged in frames in the immediate neighbourhood of emulsions sensible to gelatino-bromide of silver. The whole was then exposed for some time to solar radiations, after which the emulsions were immediately developed, when it was found that the lead caused an important photogenic action. Other analogous researches (including some on oxide of uranium) in 1922 proved that the solar impression across the lead and uranium varied considerably from one day to another, but the photogenic action ceased when the frames were so arranged that the lead or uranium were placed on the ground. During periods of strong electromagnetic intensity the actions produced by the sun were important, but were feeble in periods of solar calm. Further researches demonstrated the effect on the activity of radium and uranium, the actions being produced by radiations of an unknown nature and being stronger when the sun was in the ascendant. The resulting radiations do not seem to be of cosmic origin. The effects of ionisation and absorption of various substances under the action of these penetrating radiations appear to be a function of the atomic number of these substances. T. C. H.

3171. Magnetic Deviation of Penetrating Rays. B. Rossi. *Accad. Lincei, Atti,* 11. *pp.* 478–482, *March* 2, 1930.

The ionisation phenomena due to the penetrating radiation are produced by corpuscular rays of great energy, but it is not yet known whether the radiation itself is of corpuscular nature or if the corpuscles are originated in the atmosphere by a penetrating radiation analogous to γ-rays. In order to investigate the properties of the corpuscles the author has examined their deviation in a strong magnetic field, which gives information on their charge and velocity. The corpuscles were caused to traverse three Geiger counters and were exposed to a strong magnetic field over a considerable portion of their course, the penetrating rays being deflected in the interior of the iron core of an electromagnet. The preliminary results from the deflections observed would lead to the identification of the corpuscles of the penetrating radiation with electrons of energy corresponding to about 10^9 volts. The investigation is being continued. J. J. S.

HEAT.

3172. Heat Conduction Theory. M. Brelot. *Accad. Lincei, Atti,* 11. *pp.* 371–377, *Feb.* 11, *and pp.* 458–463, *March* 2, 1930.

The study commenced in a previous paper [see Abstract 2857 (1930)] of the equation $\nabla^2 u = cu$ is continued where u and c are functions of position in a plane, and c is positive or zero. The study is entirely mathematical, from the point of view of the establishment of existence theorems when various restrictions (wider than those of continuity) are imposed on c, and taking account of possible singularities in the function u. In the second of these two papers, the discussion, whilst still mathematical, is directed to the problem of a point source of heat in a radiating plane in thermal equilibrium. J. H. A.

3173. Thermal Convection. R. W. Babcock. *Phys. Rev.* 35. *pp.* 1008–1013, *April* 15, 1930.

The differential equations which apply to slow steady convective motion of a viscous fluid are the standard equations of hydrodynamical theory, combined with equations expressing the law of thermal interchanges in a moving fluid. Approximate solutions are found following the method outlined by Oberbeck (*Ann. d. Physik*, p. 271, 1879). A comparative study of the exact solution of a special system of non-linear ordinary equations and the Oberbeck approximate solution shows that the magnitude of the constants in the system controls the rate of convergence of the approximation, and often produces divergence. Solutions with graphs of temperature and velocity fields have been computed for special cases of cylindrical and plane boundaries with sinusoidal impressed boundary temperatures. If this temperature has a vertical gradient only, the Oberbeck method produces a null solution, corresponding to equilibrium in stratified layers. Arithmetical solutions for common liquids at ordinary temperatures show that the Oberbeck solutions diverge unless the gradient is much too small to be easily applied in laboratory practice. AUTHOR.

3174. Instability of a Compressible Fluid Heated from Below. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 26. *pp.* 170–172, *April*, 1930.

The author has already investigated the vertical gradient of temperature needed to produce convection currents in a layer of incompressible liquid [(see Abstract 1467 (1928)]. For a compressible fluid instability cannot arise until the gradient exceeds the adiabatic one. The validity is investigated of the assumption that "the excess of the actual gradient over the adiabatic which is needed in a compressible fluid is to be found by the same formula as gives the gradient necessary for instability in an incompressible fluid." It is found that this is justified if $\beta - \beta_0$ is written for β, where $\beta_0 =$ the adiabatic temperature gradient when there is no supply of heat. The previous actual numerical results, however, can be applied directly only when the density does not vary greatly within the system; they would not apply, for instance, to the earth's atmosphere without further discussion. T. B.

3175. Micro-Calorimeter. A. F. H. Ward. *Cambridge Phil. Soc., Proc.* 26. *pp.* 278–284, *April*, 1930.

The apparatus now described is a modification of one used by Tian [see Abstract 1507 (1924)]; an accuracy is claimed to 0·0005 cal. The elevation of temperature was measured by a series of iron-constantan thermocouples, with one set of junctions making good thermal contact with the tube where the heat was liberated and the others in a brass ring outside, kept in a thermostat. They were connected in series with a very sensitive moving-coil galvanometer. The Tian multiple-walled thermostat was used—three concentric copper cylinders insulated with kapok, the inner filled with water and the outer controlled by a mercury regulator. The constancy of temperature in the inner vessel was rather better than 1/500,000° C. Continuous heat evolutions could also be measured by passing a current through another set of thermocouples, when the Peltier cooling compensated for the heating and the temperature was kept down to its original value, thus avoiding cooling corrections. H. H. Ho.

3176. Criticism of the Electrical Differential Method for Measuring C_V in Gases. Part III. Rate of Cooling and Temperature Distribution in Gases. M. Trautz and M. Gürsching. *Ann. d. Physik*, 4. 8. *pp*. 985–1016, *April* 28, 1930.

Particulars are given of the apparatus employed and the method followed in obtaining by a manometric method the rate of cooling for air, CO_2 and CH_4. Since the change of temperature is only 7×10^{-3} °C., the losses by convection and radiation are very small. It is shown that the heat loss is obtained definitely to $\pm 0 \cdot 5$ %. From the relative heat losses of the measuring vessel, an approximate method is used to calculate the thermal conductivity and temperature changes in the three gases. The values obtained, compared with those given by Eucken, are smaller for air and CO_2, but greater for CH_4. The heat loss function for an infinitely long cylinder is calculated in the form $(ai/R^2) \leq 0 \cdot 05$. [See Abstract 2762 (1928).] R. S. R.

3177. Rotation-Components of the Specific Heats of Water Vapour and of Certain Gases. F. Henning and E. Justi. *Zeits. f. techn. Physik*, 11. 6. *pp*. 191–194, 1930.

In comparing experimental values (Reichsanstalt) of the specific heat at constant pressure with those obtained theoretically by use of the Planck-Einstein function a greater measure of agreement is obtained by investigating the *ratios* of the specific heats for two gases, these ratios as determined experimentally being more accurate than individual absolute values owing to the difficulty of making precise measurements of the temperature of the gas as it enters the calorimeter. The agreement is within 1 % in the case of the ratios for air/N_2, for $(O_2 + 9 \cdot 5\ \%\ N_2)/N_2$ and for H_2O/N_2, over a temperature range 245° – 1320° K, and within $2 \cdot 5$ % for H_2O/air, but diverges more widely for ratios involving the specific heat of carbon dioxide. Study of the latter ratios should throw light on the molecular structure of CO_2. L. V. C.

3178. Thermal Method of Measuring the Vapour Pressure of an Aqueous Solution. A. V. Hill. *Roy. Soc., Proc.* 127. *pp*. 9–19, *April*, 1930.

The thermoelectric method described for measuring the difference of vapour pressure between two solutions or between a solution and the pure solvent, depends essentially on the use of a differential wet-bulb thermometer of high sensitivity. The method requires only sufficient of the solutions to moisten 1 or 2 sq. cm. of filter-paper and occupies 35 to 40 minutes for a determination. It has a wide range and gives results accurate to within 1–2 %. T. H. P.

3179. Binary Systems with Sensibly Rectilinear Normal Isobars of Ebullition. Azeotropism. M. Lecat. *Ann. Soc. Sci. de Bruxelles*, 50. *pp.* 13–33, *April* 26, 1930.

Gives lists showing the behaviour in the ebullioscope of a number of binary mixtures, and discusses the method of determining the chemical "function" of a substance by means of the azeotropism which has been defined in a previous paper [see Abstract 1934 (1930)]. There appears to be a possibility that the method will prove to be of some practical value.
H. N. A.

3180. Internal Equilibrium in Solid Phases. A. Smits. *Phys. Zeits.* 31. *pp.* 376–382, *April* 15, 1930.

Discusses first the four "Types of Allotropy" as set out by Benedicks in 1912, previous to the publication of the author's book "The Theory of Allotropy." When, however, the curve of any given property against temperature is of the type classified by Benedicks as 2, it is not correct to infer that there is a solid solution of the second modification in the first. The particular problem of specific heats is then taken up, with special reference to the cases where there is a transformation point with no change in crystal structure. Some recent data on the specific heats of ammonium chloride and similar salts, due to Simon and his collaborators, to Ewald, and to other authors, are discussed in the light of this theory. The conclusions drawn by the various investigators from the course of the specific heat curves are not accepted in their entirety.
J. H. A.

3181. Compressibility Isotherms of Hydrogen, Nitrogen (and their 3 : 1 Mixture) at Temperatures of — 70°, — 50°, — 25° and 20°, also of Carbon Monoxide from — 70° to 200°, and at Pressures to 1000 Atmospheres. E. P. Bartlett, H. C. Hetherington, H. M. Kvalnes, and T. H. Tremearne. *Am. Chem. Soc., J.* 52. *pp.* 1363–1382, *April*, 1930.

Full details of method and apparatus with data are given, and should be useful in the design of condenser equipment for synthetic ammonia plants whilst of especial interest in the study of equations of state for real gases. In the case of nitrogen, a curious phenomenon appears at about 380 atmospheres pressure where the deviation from the law of the ideal gas is nearly constant through the temperature range — 70° to + 100° C. Carbon monoxide also appears to be similar to nitrogen in physical properties at high pressure. In the low-pressure range, carbon monoxide is slightly more compressible than nitrogen, and in the high pressure range it is slightly less compressible. At about 375 atmospheres' pressure the deviation of carbon monoxide from the law of the ideal gas is approximately constant (1·217) through the 270° range of temperature. At this pressure the volume of a given gas mass of carbon monoxide is a linear function of the absolute temperature.
H. H. Ho.

3182. Constants of the Beattie-Bridgeman Equation of State with Bartlett's P–V–T Data on Nitrogen. W. E. Deming and L. E. Shupe. *Am. Chem. Soc., J.* 52. *pp.* 1382–1390, *April*, 1930.

Bartlett has recently extended his P–V–T measurements on nitrogen to include 10 temperatures in the interval — 70 to 400° up to 1000 atmospheres [see preceding Abstract]. The present authors now calculate the following values for nitrogen:—

$A_0 = 1528{\cdot}6 \qquad a = 0{\cdot}2748 \qquad a' = 0{\cdot}9084$

$B_0 = 1{\cdot}643 \qquad b = -\,0{\cdot}9235 \qquad c = 2{\cdot}2 \times 10^6$

for the constants in the Beattie-Bridgeman equation of state, $Pv^2 = rT[v + B_0(1 - b/v)](1 - c/vT^3) - A_0(1 - a/v - a'/v^2)$, r being correspondingly expressed in cc. atm. per gm. per degree. A method of curve-fitting has been used that accurately reproduces trends as well as actual pressures in the P–V–T relations. Pressures are found from the above equation with a root mean square deviation of 0·50 % at 4 cc. per gm., and of 0·78 % at 3 cc. per gm. Below 3 cc. per gm. the calculated pressures are invariably too low, and the discrepancy becomes very large at low temperatures and low volumes. H. H. Ho.

3183. Algebraic Equation in the Kinetic Theory of Gases. A. Rajchman. *Comptes Rendus*, 190. *pp.* 729–730, *March* 24, 1930.

A note to show that the general proposition of Frobenius (*Preuss. Akad. Wiss. Ber.* p. 471, 1908) can be deduced with greater facility by means of the method of successive approximations due to Picard. The author proceeds to such deduction, merely recording the mathematical method. S. G. B.

3184. Equation of State for Helium below 6° Absolute, and Relative Importance of Gas Degeneracy and Interatomic Forces. M. C. Johnson. *Phys. Soc., Proc.* 42. *pp.* 170–179; *Disc.*, 179–180, *April* 15, 1930.

Gas "degeneracy" (the effect of non-Maxwellian distribution of molecular velocities) is distinguished from gas "imperfection" (the effect of intermolecular forces), and it is shown that specific heat measurements cannot be used to verify theories of the former, unless account is taken of the very rapid increase of the latter at the lowest temperatures and highest pressures. Accordingly a thermodynamic method is used to calculate the sum of degeneracy and imperfection at 4° and 5° Abs. for helium. Theories of degeneracy can then be roughly tested by the extent to which they allow a residual value of the imperfection to be calculated, and determine a consistent extension of the course taken by isothermals down to 15°. The method is applied to Fermi's expressions for degeneracy, and also to Berthelot's equation of state. One of the equations alone satisfies the required condition; it is shown that on this basis degeneracy would comprise 15 % of the total departure of helium from the ideal gas laws at 4° and 5°, the remainder being due to true imperfection or intermolecular forces. AUTHOR.

3185. Thermal Ionisation and Degeneration. R. Majumdar and D. S. Kothari. *Zeits. f. Physik*, 61. 9–10. *pp.* 712–718, 1930.

The theory of thermal ionisation introduced by Saha, and developed by Fowler and Milne, Saha and Sur and Woltjer, is based on classical mechanics, and only applicable to cases in which the system is composed of non-degenerate (*nicht entarteten*) components. This, however, is not the case in the interior of white dwarfs, where on account of the enormous density the electrons form a degenerate system. Chandrasekhar has given the alterations of the ionisation formula according to the new statistics, and the authors study the effect of the radiation in the case of the white dwarfs on the lines of Saha and Sur's treatment allowing for the degeneration. They come to the conclusion that in a star like the companion of Sirius the charge z of the ionised atom must be about 89, n the number of electrons per cc. being about 10^{30}; this indicates that the atoms have reached the last stage of ionisation, and that only naked nuclei and electrons are present. **Errata,** *ibid.* 62. 1–2. p. 142, 1930. H. N. A.

SOUND.

3186. Acoustics of Buildings. W. Linck. *Ann. d. Physik*, 4. 8. *pp*. 1017–1057, *April* 28, 1930.

A detailed analysis is described of the acoustic properties of various halls and buildings using the method developed by Schindelin and Scharstein [see Abstract 3114 (1929)]. In this method an oscillographic record is made of the successive reflections of a sound impulse from the various surfaces comprising the auditorium. The original paper should be consulted for details of the buildings examined and the experimental results. [See also following Abstract.] A. B. W.

3187. Acoustics of Buildings. W. Kuntze. *Ann. d. Physik*, 4. 8. *pp*. 1058–1096, *April* 28, 1930.

The investigation described in this paper is an extension of that described by W. Linck [see preceding Abstract]. The method employed is essentially the same in the two cases, but the present paper deals primarily with interference phenomena as distinct from separate echoes from the walls of the auditorium. The paper concludes with a discussion of the rôle of binaural audition in architectural acoustics. The original should be consulted for details of method and results. A. B. W.

3188. Optimum Reverberation Time for Auditoriums. W. A. MacNair. *Bell System Techn. J*. 9. *pp*. 390–397, *April*, 1930.

The suggestion is made that the sound damping material in an auditorium should be such that the *loudness* of tones will decay at the same rate for all frequencies. To attain this the reverberation time at 80 cycles must be twice that at 1000 cycles. The change of optimum reverberation time with volume is discussed. It appears that the brain acts as a ballistic instrument concerned with not only the maximum value of loudness, but also with the effect of loudness integrated throughout a considerable interval of time. W. H. Ge.

3189. Nature and Origin of Human Speech. R. Paget. *Manchester Phil. Soc., Mem*. 73. *pp*. 111–127, 1928–1929.

The third Wilde Memorial Lecture deals with topics treated more fully in the same author's book *Human Speech* (London, 1930). W. H. Ge.

3190. Hearing by Touch. R. H. Gault. *Frank. Inst., J*. 209. *pp*. 437–458, *April*, 1930.

Describes experiments with the " teletactor," a sound-amplifier which moves a small post against the skin. Simultaneously seeing the face of a speaker and feeling the words with this device offers at least 30 % advantage over lip-reading. E. E. F. d'A.

3191. Dynamical Magnification of Sound Registration Instruments for Continuous Sine Waves. B. Gutenberg. *Gerlands Beitr. z. Geophys*. 26. 1. *pp*. 34–36, 1930.

The relation between the magnification ($\mathfrak{B}^*$) for a wave of period T and the magnification (V^*) for a very short wave as recorded on a seismometer being $V^*/\mathfrak{B}^* = [\{(T/T_0)^2 - 1\}^2 + 4h^2(T/T_0)^2]^{\frac{1}{2}}$, where T_0 is the proper period, $h = \epsilon T_0/2\pi$, ϵ being the damping constant, the relation between the corresponding magnifications (V and $\mathfrak{B}$) as recorded on an ordinary sound registration instrument is obtained by substituting in the above formula T_0/T for T/T_0. If this substitution is made, the curves for $\mathfrak{B}/V$ and $\mathfrak{B}^*/V^*$ are quite similar. C. A. S.

3192. Stifling of Sound. J. Larmor. *Cambridge Phil. Soc., Proc.* 26. *pp.* 231–235, *April*, 1930.

According to observations made by the U.S. Bureau of Standards, the absorption of energy by incident sound waves by a stifling medium such as a carpet or curtain is independent of the angle of incidence. The author endeavours to deduce the stifling theoretically and points out certain tacit assumptions which are not justified, such as that the medium at a slipping interface behaves as a perfect fluid. Under ideal conditions the absorption should vary as the secant of the angle of incidence of the sound. E. E. F. d'A.

3193. Stationary Wave Method of Measuring the Absorbing Coefficients of Materials. A. H. Davis and E. J. Evans. *Roy. Soc., Proc.* 127. *pp.* 89–110, *April* 1, 1930.

Absorption coefficients have been measured for a large number of materials. The variation of the coefficient, a, with thickness is such that a increases to a maximum when the thickness is about $\lambda/4$; this agrees with theory. Incidentally the speed of sound through cotton waste is about 210 m./sec. When the absorbing material is placed at a distance from the backing plate, the absorbing power increases very rapidly at first, diminishes to a minimum at about $\lambda/2$, and repeats for positions $\lambda/2$ apart. Perforations of board-like material cause a marked increase in its absorption. When a membrane is fixed to the front surface of a felt-like material the absorption is frequently increased, the increase being greater for lower frequencies. The difference in the coefficients as obtained by the stationary and reverberation methods is discussed; the latter coefficient is generally the greater, and the ratio of the coefficients is greatest for low frequencies. [See also Abstract 3162 (1927).] G. E. A.

3194. Vibrations of Pianoforte Soundboard. L. D. Mahajan. *Indian Journ. Phys.* 4. *pp.* 515–531, *April* 30, 1930.

The vibrations of a point of a pianoforte soundboard are recorded photographically by a device similar to that used for rocking the minor in the Phonodeik. Selected parts of the curves were analysed harmonically, and the results confirm that the lower notes of a piano are relatively richer in harmonics than are the higher. Some of the curves show the resonance frequencies of the soundboard. At two frequencies (43 and 76 vibrations per sec.) the effect of a soft pedal was studied. W. H. Ge.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

3195. Frictional Electricity. P. E. Shaw. *Phil. Mag.* 9. *pp.* 577–583, *April,* 1930.

Shows that surface films are often of the greatest importance in connection with the sign of the charges produced. Two apparently identical solids may be oppositely charged when rubbed together, owing to the fact that the strains produced in them by rubbing are different. The signs on the two rods may become reversed after long continued rubbing; this seems to be due to a difference in temperature due to friction. Normal or oblique impact between two rods of ebonite or other good insulator may produce a charge; when both are brought up to an electroscope after oblique impact a net negative charge is generally found. This implies that positive electricity (ions) has escaped to the air. The simple Volta contact theory altogether breaks down. H. N. A.

3196. Lattice-Potential of Natural and Yellow Sodium Chloride. E. Rupp. *Zeits. f. Physik,* 61. 9–10. *pp.* 587–592, 1930.

By the method previously described [see Abstract 1585 (1930)] deflected electron-intensity/volt-velocity (V) curves have been obtained for five varieties of sodium chloride by means of a beam of electrons impinging on a cube face at an angle (ϕ) of 30°; and the inner lattice potential calculated by the equation $E_0 = 150n^2/4d^2 - V \sin^2 \phi$ (d = spacing, n = order of reflection). The counterfield for (i) and (iia) was $-V/4$, for (iib) $-7 \cdot 5$ volts; in other cases $-10 \cdot 5$ volts. The crystal temperature was 80° save for (iv) when it was the ordinary: (i) Natural crystal, maxima at 18, 32, 42, 56, and 76 volts; $E_0 = -3 \cdot 5$ volts. (iia) A similar crystal coloured yellow by irradiation with 150,000-volt electrons for 5 min., the maxima shifted to 13, 30, 40, 54 and 72 volts respectively; $E_0 = -2 \cdot 8$ volts. (iib) When such a crystal is illuminated, *e.g.*, by a tungsten lamp, the maxima gradually shift back to their former values as the colour and therewith the photoelectric conductivity disappear, thus demonstrating the connection between E_0 and electron mobility, the two varying in the same sense. (iii) Blue rock-salt, an almost horizontal curve with no maximum. (iv) An evaporated layer of sodium chloride on tungsten foil, thickness about 0·001 mm., one strong maximum at 42 volts to which the value $n = 2 \cdot 5$ corresponds, for which no explanation is offered. (v) A synthetic crystal prepared by Kyropoulos' method [*Zeits. anorg. Chem.,* 154. 308, 1926], maxima generally resembling those for (i) but of relatively different values. Such a crystal is coloured by kathode radiation and decoloured on illumination much more rapidly than a natural crystal. C. A. S.

3197. Measurement of Dielectric Constants of Organic Liquids. A. O. Ball. *Chem. Soc., J. pp.* 570–596, *April,* 1930.

The dielectric constants have been determined over a range of frequency and temperature by means of an a.c. bridge. Full experimental details are given with data for hexane, benzene, acetal, chloroform, dimethylethylcarbinol, toluene-amyl alcohol mixture, iso-butyl alcohol, o-nitro-toluene and nitrobenzene; and a type of apparatus evolved by which concordant results have been obtained over the range investigated. The paper should be consulted in its entirety. H. H. Ho.

3198. Dielectric Constants of Chlorides of Sulphur. T. M. Lowry and G. Jessop. *Chem. Soc., J. pp.* 782–792, *April,* 1930.

The dielectric constants of sulphur chloride mixtures have been measured over the range of composition from monochloride to chlorine and from room temperature down to the freezing points. Details of apparatus are given. The isothermals for the liquids confirm the existence of sulphur dichloride, but do not show any inflexion corresponding with the tetrachloride, even at − 50° C. The dielectric constant of the solids shows a pronounced maximum at the composition of the tetrachloride. It would appear, therefore, that sulphur tetrachloride is stable in the solid phase, but cannot be detected in the liquid phase. H. H. Ho.

3199. Dielectric Constant and Molecular Structure of CS_2. C. T. Zahn. *Phys. Rev.* 35. *pp.* 848–854, *April* 1, 1930.

By the radio-frequency heterodyne method previously developed measurements have been made of the dielectric constant of CS_2 at various pressures and temperatures. The molecular polarisation is shown to be independent of temperature, and therefore the electric moment is zero. The previous value published tentatively is shown to be in error. The structure of the CS_2 molecule can now be considered to be rectilinear and symmetrical. The value for the molecular polarisation obtained is $p = 22 \cdot 36$. Comparisons with other data are given, and some convenient modifications in the experimental method and in the interpretation of dielectric constant data are described. [See also Abstract 282 (1929).] AUTHOR.

3200. Variation of Dielectric Constant with Temperature. Part I. Electric Moments of Carbon Bisulphide and Nitrous Oxide Molecules. C. H. Schwingel and J. W. Williams. *Phys. Rev.* 35. *pp.* 855–862, *April* 1, 1930.

An apparatus has been described which makes it possible to determine dielectric constants of gases and vapours and their dependence on temperature over a range of several hundred degrees. The electric moments of gaseous carbon bisulphide and nitrous oxide have been measured and found to be zero. These results indicate a linear arrangement of the three atoms forming each molecule. AUTHORS.

3201. Determination of Electric Moment of a Molecule from Temperature Behaviour of Dielectric Constants. R. Sänger. *Phys. Zeits.* 31. *pp.* 306–315, *April* 1, 1930.

It is concluded that measurements of the temperature behaviour of the dielectric constants of gases and vapours can only be used for the exact determination of the electric moment and of the term independent of temperature in the expression for static molecular polarisation, when they are accompanied by corresponding exact measurements of the state constants. The exact values for the electric moments μ of water and ethyl ether are found to be: water, $1 \cdot 842 \pm 0 \cdot 008$, and ethyl ether, $1 \cdot 146 \pm 0 \cdot 012$. The infra-red term of molecular polarisation requires redetermination.
H. H. Ho.

3202. Electric Moment of Colloidal Particles. J. Errera. *Kolloid Zeits.* 51. *pp.* 104–105, *April,* 1930.

The special behaviour of the dielectric constant of V_2O_5 hydrosol (very high value; dependence on frequency and field strength; an electrical analogy with ferromagnetism) makes the electric moment of the vanadic anhydride particle of particular interest. Details of its calculation are given and a value 415×10^{-18} found. The rods of vanadic anhydride have a moment, therefore, which is a hundred times as great as that of the molecules of ether, water, and nitrobenzene respectively. It is concluded that in process of time colloids coalesce to form rods with a simultaneous orientation of atoms and molecules within the colloid so that an electric moment first arises and then increases. H. H. Ho.

3203. Electric Moments of Aromatic Diamines. J. W. Williams and J. M. Fogelberg. *Phys. Zeits.* 31. *pp.* 363–365, *April* 15, 1930.

This paper continues an investigation of the relationship between the magnitudes of the electrical dipole moments and molecular structure, and contains measurements for ortho-, meta-, and para-phenylene diamines. It is established that meta- has the greatest moment and this case appears to be the first on record where the meta-dipole moment exceeds those of the corresponding ortho- and para-derivatives. H. H. Ho.

3204. Investigation of Lightning. O. Prochnow. *Phys. Zeits.* 31. *pp.* 335–338, *April* 1, 1930.

The author replies to criticisms by B. Walters of the reality of the photographs of lightning published in the author's book *Erdball and Weltall* [see Abstract 3123 (1929)]. He considers the exceptional darkening of the photographic negative vouches for the accuracy of the picture. The form of the ball lightning and the form similar to the string of pearls and the sinusoidal path cannot be imitated without special preparation. The photograph of lightning by R. Suring is also discussed. R. S. R.

3205. Electric Potential Distribution Around a Point in the Earth. S. Stefanesco and C. and M. Schlumberger. *J. de Physique et le Radium*, 1. *pp.* 132–140, *April*, 1930.

Mathematically considers the problem of potential distributions in the interior of horizontal homogeneous and isotropic earth layers. The method of solution is based on the generalized use of Bessel functions of the first order and it is found possible to express in a definite integral form the potential in each of the layers irrespective of their numbers, thicknesses and specific resistances. The paper should be consulted in the original. R. C. F.

3206. Solar Ultra-Violet Radiation as the Cause of Auroræ and Magnetic Storms. S. Chapman. *Roy. Astron. Soc., M.N., Geophys. Suppt.* 2. *pp.* 296–300, *April*, 1930.

The author examines the theory advanced by Hulburt and Maris to account for these phenomena [see Abstracts 2631 (1928)] and 2603 (1929)]. Their ultra-violet radiation theory can account only for very slow moving corpuscles in the polar regions and these could not penetrate to the observed lower limit of auroræ. Even the solar stream theory giving faster corpuscles offers some difficulties. Further, this theory cannot account for such properties as the extreme thinness of the auroral curtains and streamers. It fails to account for magnetic storms in that the major cause of the decrease of horizontal force (H.F.) in the main phase of the storm-time variation is external, not internal. It is therefore not due to earth currents or atmospheric drift-currents which can only increase the H.F. Further, it does not account for the very definite and intense average features of the magnetic disturbance field in the neighbourhood of the auroral zone. R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

3207. Temperature-Conductance Curves of Solid Salts. Part III. Halides of Lithium. D. C. Ginnings and T. E. Phipps. *Am. Chem. Soc., J.* 52. *pp.* 1340–1345, *April,* 1930.

Continuing previous work [see Abstract 3153 (1929)], the conductance-temperature curves for solid lithium halides were determined. The determinations were made at temperatures from room temperature up to the melting point. Two slopes were found for lithium halides, a behaviour which had previously been observed for sodium and potassium halides. The theory put forward to explain this phenomenon was that the lithium ion alone conducts at the lower temperature, and at the higher temperature both the lithium ion and the halide ion take part in the conduction. F. J. B.

3208. Resistance of Bismuth Crystals and Purity of the Metal. L. Schubnikow and W. J. de Haas. *K. Akad. Amsterdam, Proc.* 33. 4. *pp.* 350–362, 1930. *In German. Comm. No.* 207*c from the Phys. Inst., Leiden.*

The results of resistance measurements of monocrystals at 0° C. and 20·37° K. show that the ratio between these two quantities varies very greatly from case to case. This depends in part on the direction of the axes of the crystal in the bismuth rod, and perhaps in part on the method of preparation of the crystal. Careful investigation, however, shows that many of the variations depend on the presence of impurities, minute quantities of which may affect the ratio very greatly. Frequent recrystallisation of the monocrystal, in which the end of the rod opposite to the crystal bud was cut away each time, and the surface of the rod was etched with nitric acid, resulted in great reductions in the ratio $R_{20\cdot37K}/R_{0^\circ C.}$, and the spectral lines due to impurities disappeared at the same time. Differences due to different methods of preparation of the rod seem to depend on the different ways in which the impurities are distributed in it in the different cases. H. N. A.

3209. Resistance Changes of Bismuth Crystals in a Magnetic Field at the Temperature of Liquid Hydrogen. L. Schubnikow and W. J. de Haas. *K. Akad. Amsterdam, Proc.* 33. 4. *pp.* 363–378, 1930. *In German. Comm. No.* 207*d from the Phys. Inst., Leiden.*

Describes measurements with a crystal of pure bismuth, with the crystalline axis parallel within 1° to the axis of the rod. This could be rotated about its axis, and it was found that the resistance readings were repeated after rotation through 60°. For moderate field intensities the curve showing the relation between $R_H/R_{0^\circ C.}$ and the angle through which the rod was turned was regular, somewhat resembling a sine curve. For high fields the shape of the curve changed, being in some cases flat and in others very pointed at the top, while for $H = 24\cdot990$ and $H = 27\cdot500$ k.g. there were two maxima in 60°, with a minimum where for smaller fields the maximum was found; for $H = 29\cdot200$ and $30\cdot140$ k.g. there were three maxima. It is clearly dangerous to draw conclusions from observations on polycrystalline wires, as Kapitza has done, since the relations are so complicated in individual crystals. H. N. A.

3210. Thomson Effect in Zinc Crystals. L. A. Ware. *Phys. Rev.* 35. *pp.* 989–997, *April* 15, 1930.

The Thomson coefficient σ is directly determined for a group of zinc crystal rods with orientations distributed fairly uniformly over the entire possible range. At 49·5° C. and at 125° C. the values of σ seem to obey the Voigt-Thomson symmetry relation, although not as good a check is obtained at the higher temperature on account of increased experimental error. The principal values obtained are in cal. coul.$^{-1}$ deg.$^{-1}$:

Temperature °C.	$\sigma\perp$	$\sigma\parallel$
49·5	$0 \cdot 98 \times 10^{-6}$	$0 \cdot 38 \times 10^{-6}$
125	$2 \cdot 09 \times 10^{-6}$	$1 \cdot 08 \times 10^{-6}$

The values at 49·5° C. are found to compare favourably with values for polycrystalline zinc calculated from Sommerfeld's theory of conduction, ($0 \cdot 32 \times 10^{-6}$ cal.coul.$^{-1}$ deg.$^{-1}$), and found by Borelius experimentally, ($0 \cdot 88 \times 10^{-6}$ cal.coul.$^{-1}$ deg.$^{-1}$). The increase of σ with increased temperature is greater than has been previously reported for polycrystalline zinc but is in approximate agreement with some earlier determinations by the writer. In addition, specific resistivity and temperature coefficient of resistivity are determined. AUTHOR.

3211. Hall Effect in Weak Magnetic Fields. E. Bossa. *Accad. Lincei, Atti,* 11. *pp.* 482–489, *March* 2, 1930.

The Hall effect for Ni, Fe and Cu in very weak magnetic fields was measured by a sensitive method in which a triode valve was employed. The course of the Hall coefficient in weak magnetic fields is substantially different for Ni and for Fe from that in strong fields: the gradual increase which is observed on diminishing the field changes into a rapid increase commencing at about 30 gauss for Ni and about 6·2 gauss for Fe, and this course is maintained up to the limits reached in the experiments, 2 gauss for Ni and 0·2 for Fe. For these substances dissymmetry of the galvanometric deviations occurs with inversion of the magnetic field. With Cu there is no trace of dissymmetry, and the Hall coefficient shows a slight increase with diminution of the magnetic field up to the limit of about 1 gauss attained in the experiments. J. J. S.

3212. Hall Effect, Electrical Conductivity and Thermoelectric Power of Lead-Antimony Alloys. E. Stephens. *Phil. Mag.* 9. *pp.* 547–560, *April,* 1930.

The alloys were carefully annealed. It was found that the Ettingshausen effect was in all cases inappreciable. The curves for each of the effects in relation to the concentration of one of the metals in the alloy are in all cases continuous, with no irregularities; but there is no indication of any close connection between any of the phenomena concerned. Annealing produced a diminution in resistivity in all the alloys. H. N. A.

3213. Obstructed Glow-Discharge. Part II. A. Güntherschulze. *Zeits. f. Physik,* 61. 9–10. *pp.* 581–586, 1930.

The work described in the first part [see Abstract 2634 (1930)] is repeated, using a kathode of " electron-metal " (Mg—Al), when the phenomena are more marked than when an iron kathode is used, while the laws obeyed are the same. On the other hand it is more difficult to prevent the appearance of the negative glow. At low pressures the discharge no longer proceeds from the whole area of the kathode, but shrinks in towards the centre more and more as the gas pressure decreases. A. C. M.

3214. Spark Potential in Pure Gases at Low Pressures. K. Zuber. *Zeits. f. Physik*, 61. 11–12. *pp*. 750–766, 1930.

Throwing the equation $(\alpha - \beta)S = \log(\alpha/\beta)$, (S = distance in mm. between electrodes, α, β, the ionisation functions) into the form $\alpha S = \log n$ (by putting $\alpha/\beta = n$, and neglecting $1/n$), with the aid of the relation $\alpha = pc_1e^{-c_2\pi/V}$ (p = pressure in mm. of mercury, $\pi = pS$, c_1, c_2 constants) the relation $\log \pi - c_2\pi/V = \log(\log n/c_1)$ is deduced. Plotting the $(\pi/V)/\log \pi$ curve from Frey's data for nitrogen [see Abstract 1681 (1928)], n is shown to be a constant (n_0) for values of π from 0·8 to 7 × $\pi_{\text{min.}}$. The equation $V = \pi(V/p)_{\text{min.}}/\{\log(\pi/\pi_{\text{min.}}) + 1\}$ is then deduced for the spark potential, and a graphic method of determining $\pi_{\text{min.}}$ and $V_{\text{min.}}$, (and hence for evaluating α) described. For the time of lag (t), by aid of Braunbek's deductions [see Abstract 444 (1927)] the equation $1/t = \text{const.}\ N\,.\,\pi/V^2\,.\,\Delta V$ is deduced (the constant depends on the nature of the gas, N = no. of primary electrons), and shown by reference to the author's experimental results [see Abstract 181 (1927)] to hold as regards proportionality to N and π, but only for small values of ΔV. Physical meanings are assigned to the constants c_1, c_2. In place of J. J. Thomson's $\pi_{\text{min.}} = \text{const.}\ \Lambda_0$, the relation $\pi_{\text{min.}} = \Lambda_0\,.\,e/k\,.\,\log n_0$ (Λ_0 = mean free path—"m.f.p."—of an electron for $p=1$; k = the ratio of successful to possible ionising collisions) is established. It is concluded that ionisation by positive ions occurs at the kathode surface; and that the m.f.p. at $V_{\text{min.}}$ is the least m.f.p. that can result in ionisation. A criterion for determining the purity of a gas is deduced from the above equation for V. C. A. S.

3215. Spark Discharge between Concentric Cylinders in Air. T. Nishi and Y. Ishiguro. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No*. 240. *pp*. 106–114, *April* 20, 1930. *In English*.

The sparkover characteristics in alternating and unidirectional fields have been determined for the discharge between concentric cylinders in air. The allied dielectric phenomena have also been studied. The sparkover value is high when the diameter of the inner cylinder is small. As the diameter is increased the sparkover value suddenly falls sharply and then rises slowly to a maximum and subsequently decreases. F. J. W.

3216. Under-Water Sparks. H. Conrad-Billroth. *Zeits. f. Instrumentenk*. 4. *pp*. 268–272, *April*, 1930.

Sparks between aluminium electrodes under water are often used as source of light for absorption measurements in the ultra-violet. A description is given of an apparatus for the automatic regulation of the position of the electrodes for use with under-water sparks. J. J. S.

3217. Corona Discharge. H. A. Gould. *Frank. Inst., J*. 209. *pp*. 485–501, *April*, 1930.

A review is given of existing conceptions of the nature, mechanism and effects of corona discharge on h.t. transmission lines. A. W.

3218. Purification of Gases by Corona Discharge. R. Ladenburg with H. Sachsse. *Ann. d. Physik*, 4. 7. *pp*. 863–897, *April* 15, 1930.

A general account of the method for removing dust and other suspended particles from gases by means of a corona discharge from a metal wire or band stretched along the axis of the earthed metal pipe through which the gas passes. In the present paper attention is mainly paid to the way in which the suspended particles are charged by means of negative ions sent out from the central wire. The maximum charge of a particle depends on its size, and on the field in the space between the electrodes, which gives the ions the velocity which drives them into the particles. The electrical image of the charge on the ion produced in a conducting particle (which is treated as spherical) is also of importance in enabling it to become charged. Calculates the velocity that can be produced in the particles by the effect of the field on the charge in various practical cases, and comes to the conclusion that it is often insufficient to enable many of the particles to reach the wall. The effect of electrical wind from points on the wire in hastening the deposit will be considered in a future paper. H. N. A.

3219. Experiments on the Figures of de Heen and Electric Flux. A. Lafay. *Ann. de Physique*, 13. *pp.* 349–394, *April*, 1930.

After a short account of the method used by de Heen a description is given of an improved method. A plate (P) of a good insulating and non-hygroscopic material, such as resin, is placed on a metal plate connected to the negative pole of a Wimshurst machine. Above P is a metal plate pierced with a number of small holes or slots according to the figure desired. This plate is earthed, as is also a wire connecting the outer coatings of two Leyden jars whose inner coatings are connected to the terminals of the Wimshurst machine, the positive terminal of which is connected to a discharge point at a suitable distance above the pierced metal plate. Typical discharge figures are reproduced. Two methods were used to determine the mobilities of the electrified particles concerned. The values obtained by the two methods were in fair agreement, the mobility of the positive particles being of the order of 1·6 and of the negative particles 1·7 cm.^{2}/volt/sec. Positive aggregates were observed in intense fields, the carriers for these aggregates having velocities of about 10^5 cm./sec. A. W.

3220. Plasmoidal H.F. Oscillatory Discharges in "Non-Conducting" Vacua. R. W. Wood. *Phys. Rev.* 35. *pp.* 673–693, *April* 1, 1930.

The new type of vacuum tube discharge (termed plasmoidal) has been studied in greater detail. It is shown that the luminous bodies formed in the discharge are built up of excited molecules, since their spectra are molecular band spectra (O_2 or CO). Surface charges appear to play an important part in their formation. F. J. W.

3221. Characteristics of Discharge Tubes Under "Flashing" Conditions with the Kathode-Ray Oscillograph. W. A. Leyshon. *Phys. Soc., Proc.* 42. *pp.* 157–165; *Disc.*, 165–169, *April*, 1930.

An account is given of a method of determining the current-voltage characteristics of discharge tubes under flashing conditions, a kathode-ray oscillograph being used. Results are given for neon lamps of the commercial Osglim type. Current/time and voltage/time curves are derived from the oscillograph records. It is suggested that the method might prove useful in investigations of intermittent discharges in various gases under different conditions of pressure and disposition of the electrodes. AUTHOR.

3222. Kathode Dark Space. E. C. Childs. *Phil. Mag.* 9. *pp.* 529–546, *April*, 1930.

Experiments were undertaken with the object of clearing up some uncertainties as to the causes of some phenomena associated with the kathode dark space and of deciding between the theories put forward by Aston and by Langmuir. Preliminary experiments were carried out in order to find the relative sizes of kathode and guard-ring for the latter to be efficient. In the tube finally employed the kathode was about 3 cm. diameter with a guard ring of diameter 7 cm. The results obtained with this tube are more nearly in agreement with Aston's law than the Langmuir space-charge law. Discussion of the results with reference to the work of McCurdy, Compton and others concludes the paper. [See Abstracts 1429 (1926) and 161 (1928)]. A. W.

3223. New Method for Measuring Excitation Voltages of Spectral Lines, and the Multiple Line Spectrum of Hydrogen. W. Finkelnburg, E. Lau and O. Reichenheim. *Zeits. f. Physik*, 61. 11–12. *pp.* 782–791, 1930.

A discharge vessel is employed in which the Faraday dark space practically fills a spherical glass vessel. The positive column fills a side tube which extends into the centre of the sphere, the positive column projecting slightly at the end. The velocity of the electrons in this dark space is small, and it can be arranged that this velocity increases gradually as the electrons penetrate into the positive column. Light from the end of this passes through a window to the slit of a spectrograph, which is parallel to the direction of the electrons. The result is that spectral lines due to a small excitation voltage are longer than those with larger excitation voltages, since their excitation commences at a greater distance from the end of the above tube, and it is possible to arrange matters so that the excitation voltage of any line can be measured by measuring its length. The multiple line spectrum of hydrogen has been examined in this way, and not only have the excitation voltages of the lines as measured been found to agree satisfactorily (within ± 0·1 volt) with those deduced from spectroscopic data, but the observations have enabled some doubtful points to be settled, and have led to the discovery of a new two-quantum term in connection with lines which were previously unclassified. H. N. A.

3224. Stationary Townsend Discharge in Relation to Space Charge. W. O. Schumann. *Zeits. f. techn. Physik*, 11. 6. *pp.* 194–201, 1930.

A mathematical calculation is given for the field distribution in a spark gap for the stationary condition, ionisation by collision occurring and diffusion and recombination being neglected, a velocity proportional to the field strength being assumed for both positive and negative carriers. It is shown that the field distortion in a spark gap with ionisation by collision is determined by the electron ionisation and the positive mobility. Its magnitude increases relatively slowly with the current. Particularly with large gap widths and small mean field strengths can the relative field distortion reach considerable values. On account of the great increase of electron ionisation with the field strength, considerable currents of the order of 0·1 A. are necessary in order to produce fields at the kathode of 100 kV/cm. or more. In the stationary condition it is found that space charge effects play a less important part than in the phenomena of surge potentials. If in fluids or in solid bodies similar effects are found with lower mobilities and reduced ionisation, then very marked field distortion is to be expected. A. W.

3225. Scattering and Diffraction of Kathode Rays. P. White. *Phil. Mag.* 9. *pp.* 641–661, *April*, 1930.

A photographic method was used for determining the distribution of intensity in an electron pencil which had been passed through a thin film of gold. The thicknesses of the gold films employed were determined from the optical transmission using a photoelectric photometer and applying in the formula the optical constants for gold determined by Hagen and Rubens. The distributions obtained consist of a central maximum, a general background, and subsidiary maxima corresponding to the electron diffraction rings. It was found that the half-breadth of the central maximum came out of the order 1 mm. against the value 10 cm. computed, assuming scattering to take place in accordance with classical theory. It is concluded that the electrons in the central spot consist partly of electrons which have passed through minute holes in the film and partly of electrons which have passed through the film without being scattered. As regards the rings, these were found to have half-breadths which were practically the same for all electron velocities and foil thicknesses worked with and were smaller than those of the central maxima. This remarkable sharpness of the electron diffraction rings remains unexplained. W. S. S.

3226. Effect of Water Vapour on Diffusion Coefficients and Mobilities of Ions in Air. J. J. Nolan and T. E. Nevin. *Roy. Soc., Proc.* 127. *pp.* 155–174, *April* 1, 1930.

The variation of the diffusion coefficient of ions in air with the water vapour content has been examined by Townsend's method and the apparatus, experimental procedure and the corrections which were applied to the results are described in some detail. The diffusion coefficient of ions of both signs exhibits a periodic variation with the vapour pressure, which result has been confirmed by determinations of the variation of the sum of the mobilities of positive and negative ions, derived from conductivity observations in weak fields. Further confirmation has been obtained by determination of the positive and negative mobilities separately, in weak fields, by the Rutherford-Child method, and by the same method it has been shown that an increase in the field strength from 1 to 1·4 volts per cm. causes the periodic variation to disappear. Results obtained by the Rutherford-Franck alternating-field method are in agreement, and it has been shown that, apart from periodic variations, the ionic recombination coefficient varies considerably with humidity. The maximum value being at about 4 mm. vapour pressure. J. G. H. B.

3227. Properties of Ionised Gases in H.F. Electromagnetic Fields. C. Gutton. *Comptes Rendus*, 190. *pp.* 844–847, *April* 7, 1930.

After describing the apparatus and the method of ionising the gas, the author established between two copper plates a high-frequency field and observed the variation of capacity of a condenser formed by the plates when the gas in a glass tube placed between them is ionised. In augmenting the ionisation a sudden variation of the capacity was observed, and he concluded the existence of a period of oscillations of electrons of ionised gas, and phenomena of resonance when the frequency of the field coincided with that of the electronic oscillations. Pedersen has explained the results without the intervention of electronic resonance and preserved the theory established by Eccles. No variation of the ionisation was found which corresponded to resonance, which is due to a period of oscillation of the electrons of the gas. The results compel one to modify the formula of Eccles and the theories derived therefrom. T. C. H.

3228. Ionisation of Helium by Potassium Positive Ions. R. M. Sutton and J. C. Mouzon. *Phys. Rev.* 35. *pp.* 694–698, *April* 1, 1930.

The earlier work [see Abstract 2266 (1929)] on the ionisation of argon and neon by potassium positive ions has been extended to helium, using ions of energy as high as 750 volts accelerating potential. At pressures between 0·01 and 0·1 mm. definite evidence has been obtained of the ionisation of helium by ions whose accelerating potential is greater than 150 or 200 volts. F. J. W.

3229. Hydrogen Molecular Ion. E. Teller. *Zeits. f. Physik,* 61. 7–8. *pp.* 458–480, 1930.

This ion, which consists of two protons and one electron, has been dealt with theoretically by a number of investigators. Difficulties have arisen in determining the excited states of the ion, and the author has developed a direct method, starting from Schrödinger's differential equation, by means of which the excited states produced when the ion is separated step by step into a proton and a hydrogen atom in the ground state are calculated. It appears that only the $3d\sigma$ state is stable, its dissociation energy is 1·35 volts, and the distance for equilibrium is 4·5 Å. It is shown that the ion has no band spectrum in the short wave-length ultraviolet. H. N. A.

3230. Behaviour of Electrons in Magnetic Fields. V. A. Bailey. *Phil. Mag.* 9. *pp.* 560–567 *and* 625–628, *April,* 1930.

Gives a new method for determining W, the drift velocity of gases in uniform electric fields, which makes it possible to measure the velocities of electrons in the presence of negative ions; this can only be done with difficulty by means of the original method of Townsend and Tizard, which employed a magnetic field perpendicular to the electric field. The new method uses the reduction in the divergence of an electronic stream produced by a magnetic field in the same direction as the electric field. The theory of the new method is worked out, and a number of different ways of applying it are described. It has been tested experimentally with hydrogen, and the results agree in this case with those obtained by Townsend's method. The effects of the negative ions on the divergence are completely eliminated in the new method. H. N. A.

3231. Secondary Electrons from Contaminated Surfaces. P. L. Copeland. *Phys. Rev.* 35. *pp.* 982–988, *April* 15, 1930.

Small quantities of grease, or condensed vapours, or foreign metal upon a metallic surface have in the past been the cause of many spurious electrical effects. Stuhlmann and Compton cite a spurious contact p.d. of some 60 volts. Using electron reflection and secondary emission as a tool, some of the properties of such surfaces have been investigated. The results indicate that surface fields are set up retarding the reflected electrons. New evidence is found for a sudden breakdown of the insulation of oils in thin films which has been investigated by Brüninghaus and by Watson and Menon [see Abstract 2579 (1929)]. The bearing of the present results on suggested interpretations of the effect is briefly discussed. AUTHOR.

3232. Diffraction of Electrons and Electronic Analysis. M. Ponte. *Ann. de Physique,* 13. *pp.* 395–452, *April,* 1930.

An apparatus is described for investigations on the electron diffraction rings given by powders (analogous method to the Debye-Scherrer method for X-rays). The powder is deposited either on a fine wire 0·1 mm. diameter or in a slit made with a razor in a piece of silver or aluminium foil of thickness 2 to 5 hundredths of a mm. Measurements with electron beams of energy ranging from 7 to 17,000 volts gave for MgO and CdO powders, diffraction ring sizes which confirmed the de Broglie law to 1%. More accurate experiments with ZnO enabled the law to be verified to 0·3%. No special effect was observed when the electron energy became high enough to excite the zinc K-radiation. The use of electron diffraction as an analytical method in determining *surface* structure is discussed, and two or three striking applications are described. W. S. S.

3233. Characteristic Energy Losses of Electrons Scattered from Incandescent Solids. E. Rudberg. *Roy. Soc., Proc.* 127. *pp.* 111–140, *April* 1, 1930.

Determines with a newly devised apparatus the velocity distribution of an initially homogeneous beam, after scattering from different incandescent targets. The energy distribution curve has a sharp peak corresponding to truly reflected electrons, and several small maxima with slightly lower energy values. These are characteristic of the target substance, and their position remains constant for all bombarding voltages with respect to the reflected peak. It is also shown with a modified apparatus that these maxima are independent of the angle of scattering. They show the characteristics to be expected if they result from inelastic collisions with the target atoms, involving definite energy changes in these such as excitation and ionisation. The energy changes do not, however, exactly agree with the values obtained from spectroscopic data for the gaseous state. Investigations on the radiation of heated solids bombarded by electrons are needed. H. N. A.

3234. Electron Scattering by Single Crystals of Non-Metallic Substances. M. v. Laue and E. Rupp. *Ann. d. Physik,* 4. 8. *pp.* 1097–1120, *April* 28, 1930.

The earlier work on the scattering of electrons at crystals has been confirmed and extended [see Abstract 1585 (1930)] Sodium, potassium, lead and thallous chlorides, iron, lead and zinc sulphides, lithium and calcium fluorides, potassium bromide and cuprous iodide have been studied and the inner potentials determined. The experiments were unable to reveal any difference in the behaviour of different crystal surfaces. F. J. W.

3235. Photoelectric Effect in Dry Rectifiers. W. Graffunder. *Phys. Zeits.* 31. *pp.* 375–376, *April* 15, 1930.

Experiments have been made with a commercial form of dry rectifier. It was found that every time the rectifier was illuminated a current was produced in the circuit connected to it; this was shown to be of photoelectric origin and not thermoelectric. The same effect was found with a detector formed by the combination Cu—Cu_2O—Pb, an oxidised copper plate being pressed against a lead plate; when a narrow beam of light fell on the edge of the copper plate a current flowed, but not when it fell on the lead plate at the same time. The direction of the current was in the opposite direction to that in the rectifier. H. N. A.

3236. Application of the Photoelectric Cell to Measurement of Small Displacements. J. A. C. Teegan and K. G. Krishnan. *Phil. Mag.* 9. *pp.* 589–592, *April*, 1930.

Light from a pointolite lamp is focussed by a lens on a potassium vacuum type of photoelectric cell. A slit is placed in the path of the beam just in front of the cell, and one of the jaws of the slit is fixed to the end of the object the displacement of which is to be measured. Movement of this jaw alters the amount of light which reaches the cell, and the alteration in the current from the cell is amplified by means of a triode valve to which it is connected. Certain difficulties connected with the use of the apparatus are dealt with. H. N. A.

3237. Electric Oscillations in a Photoelectric Cell. B. L. Rosing. *Zeits. f. techn. Physik*, 11. 6. *pp.* 177–182, 1930.

Circuits consisting of a photoelectric cell and a resistance with a high e.m.f., and shunted with a capacity, can produce independent oscillations. When $de/di < 0$ two kinds of oscillations are possible. One of these takes place when the ohmic resistance exceeds the wave resistance and $de/di < L/CR$ and therefore the resistance is negative. The other kind of oscillations occurs when $de/di > R$. Both kinds are experimentally confirmed by the extinction of the oscillations by light. The author has applied this observation to construct a reading machine for the blind. E. E. F. d'A.

3238. Detectors. J. Vrede. *Phys. Zeits.* 31. *pp.* 323–332, *April* 1, 1930.

Chemically prepared lead sulphide after gentle heating was found to be a good detector, but the efficiency decreased when the material was purified by sublimation *in vacuo*. Repeated sublimations caused the detecting action to disappear altogether. Pure tellurium also showed little detecting action, but the addition of impurities to the material apparently altered this property very considerably. No detecting action was found for a number of pure oxides, nitrides and carbides. Zinc sulphide in the pure state is an insulator. When illuminated by ultra-violet light it conducts and shows detecting action. Conducting, impure zinc sulphide rectifies without illumination, but the rectification is very greatly increased if ultra-violet light is applied. A. W.

3239. Measurement of Capacitance and Inductance in Terms of Frequency and Resistance at Radio Frequencies. C. P. Boner. *Rev. Sci. Instruments*, 1. *pp.* 243–259, *April*, 1930.

A method of measuring capacitance and inductance is described, in which the product LC is found in terms of frequency by adjusting a circuit which contains the capacitance and an inductance to resonance, the ratio L/C is found in terms of resistance by a high-frequency bridge, and the value of C is finally calculated by solving the two equations for LC and L/C simultaneously. A method of eliminating the effect of condenser leads is described. The bridge equations are derived and the effects of residuals in the arms are discussed. Details are given concerning the construction of the bridge, the oscillators and the heterodyne detector, and concerning essentials of the operating technique. Numerical results are given for a sample condenser calibration. AUTHOR.

3240. Efficacious Intensity of H.F. Currents. H. Mutel. *Comptes Rendus*, 190. *pp.* 860–862, *April* 7, 1930.

The efficacious intensity of a h.f. current can only be measured by thermal means; but two thermic ammeters of different models graduated for continuous currents do not remain comparable when used for a frequency of some millions even if correction is made for increase of resistance due to the skin effect. Experiments are described by which the principal causes of deviation were studied by making measurements of efficacious intensity with a differential thermometer and comparing the measured intensities with the indications of a thermic ammeter. The results show that thermic ammeters are only suitable for very high frequency if account is taken of the skin effect and if the walls of the enclosure are sufficiently far from the hot wire. For short wave-lengths the circuit is the seat of stationary waves and the intensity is not the same at all points. J. J. S.

3241. Electromagnetic Field of Hertzian Oscillator. Transformation of a Formula of Sommerfeld. L. H. Thomas. *Cambridge Phil. Soc., Proc.* 26. *pp.* 123–126, *April*, 1930.

The integral (involving Bessel functions) which gives the electromagnetic field set up by a Hertzian oscillator placed on the infinite plane surface separating two media, at the surface of separation itself, is transformed into a sum of two integrals involving exponential functions only. G. C. McV.

3242. Automatically Interrupted Triode Oscillator. J. A. Ratcliffe and L. G. Vedy. *Cambridge Phil. Soc., Proc.* 26. *pp.* 236–251, *April*, 1930.

A type of automatically interrupted triode oscillations is described which depends on the interaction between an oscillating triode circuit and a circuit containing a non-linear resistance and a time-constant device. The theory of the circuit is developed and tested by means of oscillograms. E. E. F. d'A.

3243. Barkhausen Effect. Part II. Determination of Average Size of Discontinuities in Magnetisation. R. M. Bozorth and J. F. Dillinger. *Phys. Rev.* 35. *pp.* 733–752, *April* 1, 1930.

Working with iron crystals, iron wire and several nickel-iron alloys (permalloys) in a slowly changing magnetic field, the magnitude of the discontinuities is determined in terms of the greatest average volume of material the magnetisation of which must be reversed at saturation in order to produce the observed change. The average size is greatest on or near the steepest part of the hysteresis loop; it is much the same for all the materials examined, and varies from $1\cdot2 \times 10^{-9}$ to 45×10^{-9} c.c. [See also Abstract 1187 (1930).] G. E. A.

3244. Method of Comparing Small Magnetic Susceptibilities. R. A. Fereday. *Phys. Soc., Proc.* 42. *pp.* 251–262; *Disc.*, 262–263, *April* 15, 1930.

A method of the non-uniform field type is described. It possesses the specific advantage that the force exerted on the specimen is constant over a wide region of the field, so that a careful setting to a position of maximum force is rendered unnecessary. AUTHOR.

3245. Magnetic Susceptibility of Rubidium. C. T. Lane. *Phys. Rev.* 35. *pp.* 977–981, *April* 15, 1930.

In view of the theoretical interest involved in Pauli's theory of paramagnetism, the author has reinvestigated the magnetic susceptibility of rubidium. The metal used is subjected to double distillation in vacuum to ensure purity. The technique employed for this is fully described. The susceptibility is determined at nine different field strengths ranging from approximately 9 to 25 kilogauss. No variation in the susceptibility of more than 2 % is observed over this range. The estimated error in the mean value of the susceptibility is between 2 and 3 %. The uniformity of the susceptibility, accordingly, shows absence of serious ferromagnetic impurity. The mean value of the mass susceptibility is found to be $+ 0{\cdot}21_7 \times 10^{-6}$ at 20° C., the Pauli theoretical value being $+ 0{\cdot}32 \times 10^{-6}$. A table is included showing the results found by all other investigators on this subject. The bearing of the results on the Pauli theory is discussed briefly. AUTHOR.

3246. Permeability of Iron. A. Ebinger. *Zeits. f. techn. Physik*, 11. 6. *pp*. 221–227, 1930.

The permeability of ferromagnetic material when magnetised simultaneously with d.c. and a.c. was investigated, and its connection with the pre-magnetisation examined by means of a.c. measurements. Some approximate methods for the calculation of the permeability are considered and their applicability shown. J. J. S.

3247. Magnetostriction Constant for Alternating Magnetic Fields. F. D. Smith. *Phys. Soc., Proc.* 42. *pp*. 181–189; *Disc.*, 189–191, *April* 15, 1930.

A magnetostriction constant K for the Joule effect is defined by the equation $p = KH$, where p is the alternating mechanical stress produced by a small alternating magnetic field H superposed on a steady magnetic field H_0. It is shown that the alternating intensity of magnetisation I produced by an alternating strain $\delta l/l$ is given by the equation $I = K\delta l/l$, K being the same constant in both equations. These equations are used to calculate the motional impedance of a laminated ring toroidally wound and vibrating in its fundamental radial mode. K has been measured for various values of H_0 with a ring of the alloy Fe 60 %, Ni 40 %. It is shown that the magnetostriction effect for steady magnetising fields can be inferred from the measurements with alternating magnetic fields, if the reversible permeability and the differential permeability of the alloy are known. AUTHOR.

3248. Measurement of Intensity of H.F. Magnetic Fields. R. H. Mortimore. *Phys. Rev.* 35. *pp*. 753–762, *April* 1, 1930.

Two methods are developed for the measurement of the intensity of magnetic fields produced by currents of frequencies from 10 to 25 megacycles. By the first method, the current in a coil is computed from vacuum tube voltmeter readings of potential drop across a standard inductance. The values for current thus obtained are compared with readings of thermo-ammeters in the range for which they are calibrated. For larger currents, the instruments are shunted and calibrated for particular wavelengths by the standard inductance method. From these known values of current the intensities of the fields which they produce are computed. By the second method, the e.m.f. induced in a single turn coil placed in the field to be measured is indicated by a vacuum tube voltmeter. The field intensity necessary to induce the observed e.m.f. is computed. Good agreement is found between the results obtained by the two methods. Improvements are made in vacuum tube voltmeter design which make possible their use in voltage measurements at frequencies as high as 25 megacycles. Information regarding current distribution in a coil is obtained. AUTHOR.

3249. Magnetic Moment of the Atomic Nucleus. J. Dorfman. *Comptes Rendus*, 190. *pp*. 924–925, *April* 14, 1930.

Shows by calculation from the observed magnetic moments of the atoms, taking into account the magnetic moments, if any, due to the external electrons, that the atoms which contain 2, 3, 4, 5, 6 or 7 electrons in their nuclei do not possess magnetic moments greater than one-tenth of a Bohr magneton. This implies that the moment of the spinning electron is not observed inside the nucleus, and agrees with the spectroscopic results. Suggestions are made as to the reason for this. H. N. A.

3250. Constitutive Equations in Electromagnetic Theory. C. Kaplan and F. D. Murnaghan. *Phys. Rev*. 35. *pp*. 763–777, *April* 1, 1930.

The constitutive relations, $B = \mu H$ and $D = \epsilon E$, of electromagnetic theory are studied from the point of view of the isotropy of space-time. The two fundamental electromagnetic tensors $a_{rs}(\equiv B, cE)$ and $b_{rs}(\equiv -D, cH)$ are supposed related by a "structure-tensor" of the fourth rank, c^{bq}_{ns}, so that $a_{rs} = c^{pq}_{rs} b_{pq}$. Isotropy of space-time having been defined by means of orthogonal ennuples, the effect on the structure tensor of various assumptions as to the character of the isotropy, is developed The constitutive relations with μ and ϵ independent are found to correspond to isotropy with regard to a general rotation of space-time about the time-direction; whilst, if $\mu\epsilon = 1$, they correspond to isotropy with regard to rotation about a point. The analysis is also applicable to elasticity theory. G. C. McV.

APPARATUS AND INSTRUMENTS.

3251. H.T. Apparatus for Laboratories. E. Pugno-Vanoni. *N. Cimento*, 7. *pp*. 128–141, *April*, 1930.

A description is given of three sets of apparatus used in modern h.t. installations in physical laboratories. (1) The first group can provide in a.c. powers of 15 kVA functioning in monophase up to 300 kV and in triphase up to 170 kV. (2) The second group is fitted to give alternating tensions up to 100 kV, constant continuous tensions up to 220 kV and tensions with rectified pulsations up to 330 kVm. (3) The third group gives only continuous current (maximum 0·5 A.) at tensions between 5 and 20 kV, presenting an alternating residuum less than 0·1 %. J. J. S.

3252. Theory of the Electrometer, Especially of the String Type Electrometer. E. Perucca. *Zeits. f. Instrumentenk*. 4. *pp*. 257–267, *April*, 1930.

From the deflection x of the electrometer needle formulæ are deduced as functions of the unknown potential difference V_x(x and V_x very small) both with heterostatic needle connection and with heterostatic plate connection. There is found with the leaf electrometer and also with the string electrometer a difference of sensitiveness in the two connections. This difference does not exist in the case of the quadrant electrometer. In this aspect the quadrant, the leaf, and the string electrometers (and still more the string electrometer of Perucca and the string electrometer of Lindemann and Keeley) exhibit a quite characteristic behaviour. J. J. S.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3253. The Mecapion, an Ionisation Apparatus for the Absolute Measurement of X-Ray Dose. E. J. H. Roth. *Brit. J. of Radiology*, 3. *pp*. 155–160, *April*, 1930.

A description of a direct reading and self-recording ionisation instrument for use in X-ray therapy. W. V. M.

3254. New Hot Kathode X-Ray Tube with Rotating Anode. W. R. Gray. *Brit. J. of Radiology*, 3. *pp*. 171–177, *April*, 1930.

A metal protected X-ray tube is described in which, to facilitate cooling, the anode is rotated upon the principle of the induction motor, by means of stator coils wound external to the tube. The advantages of anode rotation, as respects cooling of the target, are discussed. B. J. L.

3255. Mechanics of Construction of X-Ray Apparatus. G. Grossmann and H. Kress. *V.D.I.* 74. *pp*. 418–430, *April* 5, 1930.

Deals with the mechanical construction of X-ray apparatus such as X-ray screening, the stand, the X-ray couch, Potter-Bucky screen apparatus, plate-changing apparatus and protective apparatus of the Holfelder type. The subject is discussed in far greater detail, as regards the mechanical construction, than is usual in papers of this type, and illustrated by diagrams of the mechanism used to produce desired results. B. J. L.

3256. Technology of Valve Tube Construction. A. Ungelenk and J. Wiehr. *V.D.I.* 74. *pp*. 431–436, *April* 5, 1930.

The development of the electron-valve tube is discussed with reference to its use in radiological work and its construction. Subjects dealt with are the construction and preparation of anode and kathode, methods of cooling, methods of sealing the glass and metal parts and the physical principles involved, methods of pumping and gassing the glass and metal. Electron X-ray tubes having their own metallic protection are discussed as regards construction and manufacture. The paper is well illustrated. B. J. L.

3257. Physical and Technical Basis of Diathermy. H. Herrmann. *V.D.I.* 74. *pp*. 437–438, *April* 5, 1930.

Describes the basic principles of diathermy treatment and the construction of apparatus employing the spark-gap method of exciting h.f. currents. B. J. L.

3258. Use and Abuse of Radium Needles. F. L. Hopwood and (Miss) F. E. Smallman.

Some economic and administrative aspects of a hospital radium service. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3259. Heat of Adsorption of Carbon Dioxide on Charcoal Calculated by Means of Polanyi's Theory of Adsorption. J. K. Dixon. *J. Phys. Chem.* 34. *pp.* 870–874, *April*, 1930.

The paper consists of a development of the theory of adsorption of carbon dioxide on charcoal, from the work of Polanyi and Goldmann [see Abstract **1999** (1928)]. The data of Magnus and Kalberer, and of Lowry and Olmstead were utilised to calculate the various factors required to obtain the heat of adsorption. Close agreement was obtained, a poor determination showing up as a very abnormal value in an otherwise uniform series. Polanyi's theory postulated a compression of the gas on the surface of the adsorbent, and the results agreed reasonably well with this theory. F. J. B.

3260. Boundary Surface Activity and Orientation of Polar Molecules with Reference to Temperature and the Nature of the Surface of Separation. Part VI. Boundary Surface Properties of Aromatic Amines and Their Salts. P. Rehbinder and A. Taubmann. *Zeits. f. Phys. Chem.* 147. *Abt. A.* 3. *pp.* 188–205, *April*, 1930.

Measurements are given for the surface tension of aqueous *p*-toluidine solutions at different concentrations and temperatures. The results obtained in former investigations are confirmed. Surface tension increases with temperature in certain definite temperature intervals, which is to be ascribed to a decrease in adsorption with temperature. The various isotherms are discussed, the " surface lattice constants " of orientation of *p*-toluidine are found, and from measurements at different *p*H values it is shown that only the toluidine molecules are active, while the ions of toluidine salts are inactive; accordingly, we have here a method for determining quantitatively active aromatic bases. [See also Abstract **470** (1928).] J. K.

3261. Influence on Ideal Solution Laws of Distribution of Polarity within the Molecule. J. H. Hildebrand and J. M. Carter. *Nat. Acad. Sci., Proc.* 16. *pp.* 285-288, *April*, 1930.

From a consideration of the solutions of benzene with nitrobenzene, with the three dinitrobenzenes and with 1: 3: 5—trinitrobenzene, it is concluded that the number and polarity of the substituent groups rather than the electric moment of the whole molecule determine deviations from Raoult's law. When, however, the field of a polar band is sufficiently buried within the molecule its influence upon solubility tends to disappear. H. H. Ho.

3262. Mixtures of Iodine Vapour and those of Different Solvents. M. Chatelet. *Comptes Rendus*, 190. *pp.* 927–929, *April* 14, 1930.

When a solution of iodine in benzene is vaporised at 90° C. an absorption band is observed which does not belong either to the vapour of iodine or to that of benzene. The author has studied the vapour density of the mixed vapours, and finds that there is a contraction in volume, which he interprets as due to the fact that each iodine molecule groups a number of molecules of the other vapour round it, forming a molecular association. The number of these associated benzene molecules is 10, and corresponding numbers have been found for other solvents. These numbers are inversely proportional to the mean free paths of the associated molecules, or proportional to the number of collisions per second between these molecules and those of the free solvent. H. N. A.

3263. Viscosity Formula for Binary Mixtures. Part VI. T. Ishikawa. *Chem. Soc. Japan, Bull.* 5. *pp.* 117–121, *April,* 1930. *In English.*

Continuing previous work [see Abstract 2679 (1930)], the author discusses the work of Macleod, and by the aid of the results of his viscosity determinations calculates the constants of the viscosity equations. The viscosity equations of Dunstan and Wilson, of Gartenmeister, and of Macleod are compared, and a satisfactory degree of agreement between the constants derived from the numerical results is obtained. F. J. B.

3264. Heats of Formation of Mixed Crystals of the KCl-KBr Series. M. M. Popoff, A. Bundel and W. Choller. *Zeits. f. phys. Chem.* 147. *Abt. A.* 4. *pp.* 302–318, *April,* 1930.

Determinations of the heats of solution and, from these, of the heats of formation by means of the adiabatic calorimeter show that mixed crystals of the series KCl–KBr obtained in different ways exhibit different heats of formation. Such difference is not observed with mixed crystals having melting points near to the minimum melting point of the mixed salts, except when the salts are obtained by grinding or by slow crystallisation, with tempering; mixed crystals prepared by the last method exhibit the greatest absolute heats of formation. T. H. P.

3265. New Method of Examination of Surface Films. J. H. Schulman and E. K. Rideal. *Cambridge Phil. Soc., Proc.* 26. *pp.* 273–277, *April,* 1930.

Existing methods for the quantitative examination of the behaviour of two-dimensional insoluble films on water surfaces are discussed, following which a new method is described which consists essentially in measuring the potential difference between a platinum wire situated above the surface of a glass Langmuir trough and a calomel electrode establishing contact with the liquid in the trough. A small quantity of polonium is electrodeposited on the platinum wire. Full details are given. With the new apparatus reproducible air liquid potential differences could be obtained, independent within relatively wide limits of variation of the height of the polonium-coated wire above the surface of the liquid, usually N_{100}/HCl, in the trough. H. H. Ho.

3266. Monomolecular Films. J. Perrin. *Kolloid Zeits.* 51. *pp.* 2–6, *April,* 1930.

This paper continues work on films which has engaged the author's attention for a long time, and in this particular investigation soap films are studied which were prepared from pure oleate made by titration of oleic acid with caustic alkali. A detailed description is given of the properties of thin films bounded on both sides by the same medium, particularly of thickness variations and discontinuities. Photographs are then examined of soap films which contain minute quantities of dyestuffs (*e.g.*, eosin). It has been found that the thickness of every layer in a liquid-stratified film is an integral multiple of the same unit layer, *i.e.* that very probably the various zones arise from superposition of identical film layers. In certain cases, at least, a discontinuous and periodic structure of matter has therefore been observed. Agreement is found concerning molecular magnitudes with the Röntgen ray results of Bragg and Friedel. H. H. Ho.

3267. Membranes for High-Pressure Ultra-Filtration. J. W. McBain and S. S. Kistler. *Faraday Soc., Trans.* 26. *pp.* 157–162, *April,* 1930.

Cellophane is advocated as a membrane for ultra-filtration. Some properties are described which have a direct bearing upon such a use. The adaptation of cellophane to non-aqueous solutions is described. New membranes of such density that they may be used as molecular sieves have been made, and their use in physical chemistry is illustrated by a determination of the degree of hydration of sucrose in dilute solution.

AUTHORS.

3268. Abnormal Osmosis at Non-Swelling Membranes. Part II. K. Söllner. *Zeits. f. Elektrochem.* 36. *pp.* 234–241, *April,* 1930.

Abnormal osmosis is the name given to the passage of a current of liquid through a membrane inserted between two electrolyte solutions of different concentrations with a strength or a direction not explainable by normal osmotic forces. Further consideration of this question [see Abstract 2322 (1930)] brings out the following regularities. If the two kinds of ions of an electrolyte move equally rapidly in free solution, only abnormal positive osmosis is possible at a membrane, either positive or negative, between two solutions of such electrolyte of different concentrations. If the ion moving the more rapidly in free solution is also the one which forms the movable part of the double layer in the pores, abnormal positive osmosis is alone possible; in the opposite case, either abnormal negative or abnormal positive osmosis may occur, according to the breadth of the pores of the membrane. These rules must be regarded as the foundation of Bartell's empirical law. It is shown also that abnormal osmosis in a single pore, even with participation of the substance of the membrane, does not usually take place; only if the membrane substance is a sufficiently good electrolytic conductor is such process conceivable. The possibility of the appearance of circuit currents in a single pore without interaction of the substance of the membrane is discussed, and it is concluded that motion of liquid in a single pore cannot occur spontaneously, that is, without the action of external force. T. H. P.

3269. Flocculation by Mixing Two Colloidal Solutions of the Same Nature but with Granules of Opposite Electrical Signs. A. Boutaric and (Miss) G. Perreau. *Comptes Rendus,* 190. *pp.* 868–870, *April* 7, 1930.

The flocculation produced when sols of positive and negative ferric hydroxide are mixed appears to be determined by the presence of the electrolyte used as peptonising agent in preparing the negative sol. As this electrolyte has a polyvalent anion and, when added to a sol of positive ferric hydroxide, causes flocculation only within certain limits of concentration, the introduction of the negative into the positive sol results in dilution of such electrolyte from a concentration at which it does not flocculate ferric hydroxide to one at which it does cause flocculation.

T. H. P.

3270. Charges on Colloid Particles and their Influence. A. Lottermoser and W. Riedel. *Kolloid Zeits.* 51. *pp.* 30–39, *April*, 1930.

The positively charged disperse aqueous phases of Cr, Fe_2O_3, Al_2O_3 and ThO_2 become negative on dilution with water, and the charge increases to a constant negative maximum which is defined as the specific potential (Eigen-potential) for the determination of which a method is now described. The influence of different kinds of anions upon positively charged chromium is electrokinetically investigated. Charged kations are neutralised up to the specific potential by multivalent anions, although only hydroxyl ions are able to charge chromium negatively beyond the specific potential, other anions effecting only displacements of potential. Oxygen displaces the electrokinetic potential of chromium particles towards the negative. H. H. Ho.

3271. Silver Sols Coloured with the Aid of Hydrogen Peroxide. Part II. E. Wiegel. *Kolloid Zeits.* 51. *pp.* 112–123, *April*, 1930.

Further experiments [see Abstract 2855 (1929)]. The silver sol is primarily dissolved as peroxide. A catalytic reaction then redeposits some silver, which was in true solution, on undissolved silver particles, so that, as in the Ostwald maturing process, a few particles grow at the expense of others. The non-dissolved silver acts as a germ sol. Where only a few germs are present, the solid particles formed are large and quite distinct under the microscope. They appear as bright crystals, triangular or hexagonal, of white silver, and may become microscopic. As the particle size increases, the colour of the solution changes in reflected light from blue to green, olive, brownish-red and lustrous white, and in transmitted light from yellow to red, violet, blue, green and grey. There is no difference in principle between the coloured colloidal systems and the coarsely-disperse suspensions; the transition is gradual, and the colours are not due to different modifications of silver or its compounds. The observations are in accord with those of Koller-Debye on collargol. H. B.

3272. Preparation and Stability of Colloidal Solutions of Nickel in Dry Acetone. S. J. Folley and D. C. Henry. *Manchester Phil. Soc., Mem.* 73. *pp.* 99–110, 1928–1929.

The authors give the experimental conditions necessary for the preparation of nickel-acetone sols, the high-frequency arc method of Svedberg being applied. On examining the stability of these sols the authors provisionally conclude that traces of water have a destabilising action on nickel-acetone sols, while sulphuric or hydrochloric acid has a stabilising action. The effect of ortho, meta and para organic compounds is also examined. Certain ortho and meta compounds for instance of hydroxybenzoic acid and nitranilin act as stabilisers. Para compounds appear to be indifferent. J. K.

3273. Structure of Cellulose Gel. Parts I and II. K. Atsuki and H. Sobue. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 161–167, *April*, 1930. *In English.*

Part I deals with the mechanism of gelation. It is concluded that the coagulation of viscose or the lyophile sol in general is due to the interfacial surface tension between the disperse phase and medium or the difference in density between both phases. For viscose the latter is greater as the dilution is higher, the cause of which may be attributed to the inhibition of medium by the phase. Part II considers the syneresis of viscose, the velocity of which is found to be well expressed by the formulæ, $K_1 = \frac{1}{(a - E)t} \log \frac{(a - Z)E}{(E - Z)a}$, $K_2 = \frac{1}{t} \log \frac{a}{a - Z}$, where a is the initial water content of the gel, Z is the water lost during time t, E is that lost during t_∞ and K_1 and K_2 are constants. H. H. Ho.

3274. Arrangement of Microcrystals Formed by Fracture of Aluminium Wire Made from a Single Crystal. K. Fujii. *Kyoto Coll. Sci., Mem.* 13. *pp.* 101–108, *March*, 1930. *In German.*

The arrangement of the microcrystals formed by the fracture of an aluminium wire made from a single crystal has been studied by taking the appropriate Laue photographs. The arrangement was found to be partially fibrous. F. J. W.

3275. Magnesium-Manganese Alloys. G. W. Pearson. *Indust. and Engin. Chem.* 22. *pp.* 367–370, *April* 1, 1930.

Studies of the microstructures of magnesium-manganese alloys show that the solid solution area extends beyond 2·7 % manganese. F. J. W.

3276. Relation between Plasticity of Crystals and Temperature. W. Boas and E. Schmid. *Zeits. f. Physik*, 61. 11–12. *pp.* 767–781, 1930.

Describes experiments in which crystals of cadmium and of zinc were stretched at temperatures between 20° K. and the melting point, with different rates of deformation. Investigates the relation between the critical shearing force in the plane in which slip finally takes place, the temperature and the velocity of deformation; also the relation between the coefficient of hardening and the temperature. For the latter the coefficient is independent of the temperature up to about 90° K., falls rapidly above this point, and becomes nearly constant and very small at high temperatures, when hot working becomes possible. Finds that the constancy of the energy of deformation is a condition for the breaking of cadmium crystals. H. N. A.

3277. New Rapid Tests for Corrosion. K. Konopicky. *Zeits. f. Elektrochem.* 36. *pp.* 244–248, April, 1930.

The question of rapid tests for the corrosion of metals is discussed. Two technically important cases are considered, the rusting of iron in a salt solution and the behaviour of acid-resisting steel in corroding media. A rapid method of test, depending upon potential measurements, was developed, and curves are given of the results obtained. It is claimed that by this test materials can be selected which will give the best results under given conditions. F. J. B.

3278. Theory of Metallic Corrosion. Part III. G. D. Bengough, J. M. Stuart and A. R. Lee. *Roy. Soc., Proc.* 127. *pp.* 42–70, *April* 1, 1930.

When adequate control is kept over temperature, pressure, mechanical stability and chemical purity of the closed system in which the experiments are conducted [see Abstract 1003 (1929)], the corrosion rates of horizontally supported annealed zinc specimens with the total area 14·9 sq. cm. are reproducible within ± 1 % of the mean of two duplicates, throughout the whole range of potassium chloride and sulphate solutions. Similar limits of accuracy are found for commercially produced mild steel in similar dilute solutions. The results given by the oxygen absorption and loss of weight methods of measuring corrosion do not usually differ from the mean of the two by more than ± 1 %, except when small amounts are measured. As with very weak KCl solutions, so with very weak K_2SO_4 solutions, the time-corrosion curves are exponential. For zinc in two series of solutions, the corrosion rate-concentration curves are straight lines of different slopes, depending on the different rates with which oxygen reaches the metal owing to changes in oxygen solubility and available kathodic area. Hydrogen is evolved during the corrosion of electrolytic zinc in all solutions tested stronger than $N/20{,}000$, the proportion of the total corrosion due to this evolution increasing with the concentration to 17·4 % in 2 N-KCl and to 7·7 % in N-K_2SO_4. With spectroscopically pure zinc, hydrogen evolution is greatly reduced. In neither series of solutions is a straight-line corrosion curve passing through the origin obtained. T. H. P.

3279. "Uniform Movement" of Flame in Mixtures of Ethylene, Propylene or Butylene with Air. Elizabeth H. McL. Georgeson and F. J. Hartwell. *Chem. Soc., J. pp.* 733–737, *April*, 1930.

Measurements are given of the speed of uniform movement of flame in the whole range of inflammable mixtures of air and ethylene, propylene, or butylene. Reference is made to the work of Chapman on ethylene-air mixtures, his results being 14 % to 28 % lower than those obtained by the present authors. The reason for this difference is investigated and an explanation offered. J. K.

3280. Kinetics of Oxidation of Gaseous Benzene. R. Fort and C. N. Hinshelwood. *Roy. Soc., Proc.* 127. *pp.* 218–227, *April* 1, 1930.

The reaction is predominantly homogeneous. The first products are formed without pressure increase, and then oxidised further, by a mechanism rather closely resembling the oxidation of ethylene or acetylene, probably to glyoxal, formaldehyde and formic acid. The final products are steam and carbon monoxide with a smaller proportion of carbon dioxide. The rate of reaction varies according to a high power of the benzene concentration; and a high ratio of benzene to oxygen favours rapid oxidation. Over a certain range, increase in oxygen concentration may retard the reaction, though in another range the rate increases with oxygen concentration. Comparatively short reaction chains are probably propagated, the variation in the length of which gives rise to the abnormal influence of temperature and pressure on the velocity. From the much greater sensitiveness of the rate to benzene than to oxygen concentration it is concluded that chains are propagated more readily when the initial oxygenated product encounters another molecule of hydrocarbon than when it is oxidised further by oxygen. These results are analogous to those found in the oxidation of ethylene, and have suggested the investigation of the oxidation of a substance such as methyl alcohol, already containing oxygen in its molecule. AUTHORS.

3281. Heat of Dissociation of Carbon Monoxide. J. Kaplan. *Phys. Rev.* 35. *pp.* 957–959, *April* 15, 1930.

The author's method for calculating the heat of dissociation of nitrogen [see Abstract 2683 (1929)] has now been applied to carbon monoxide. For both N_2 and CO the method agrees with the best values obtained by other methods. Using the present value of 10·3 volts for the heat of dissociation of CO, the dissociation products of the molecule are discussed for several electronic levels. In this way it is shown that the recent value of 1·3 volts for the energy of the metastable $^1D_2$ state in oxygen, obtained by McLennan and Crawford, agrees best with the present work. AUTHOR.

3282. Evolution of Hydrogen Sulphide from Vulcanised Rubber. E. Wolesensky. *Bureau of Standards, J. of Research,* 4. *pp.* 501–513, *April,* 1930.

The rubber-sulphur compound in vulcanised rubber splits off hydrogen sulphide at all times and at all temperatures between 25° C. and the temperature of complete thermal decomposition. The rate of evolution of the gas depends upon the temperature, time, the proportion of combined sulphur, and possibly other factors. The reaction affords a new explanation of the formation of hydrogen sulphide during vulcanisation, and possibly also, in part at least, of the excess of combined sulphur over that required by the formula C_5H_8S. It may also be another factor in ageing, though, perhaps, only a minor one, and presents a new problem in the regeneration of rubber. AUTHOR.

3283. Thermodynamics of Systems with Several Equilibria. N. v. Raschevsky. *Zeits. f. Physik,* 61. 7–8. *pp.* 511–524, 1930.

In this paper a revised and more vigorous investigation is given of the case of a reversible reaction between two substances which obey van der Waals' equation [see Abstract 2350 (1930)]. The previously indicated results respecting the presence of two states of equilibrium and the evolution of certain hysteresis effects are confirmed and are now illustrated by a mathematical example. The possibility of a complication by the splitting up of the system into two coexisting phases has been investigated, and interesting consequences are now indicated which follow from the assumption of the possibility of such manifold equilibria existing within the particles themselves of a colloidal solution, *viz.*, all the particles may be so stable that no precipitation occurs by addition of ions (naturally within certain limits) or have controlled precipitation conditions. H. H. Ho.

3284. Measurement of the Affinity between Iodine and Electrons. J. E. Mayer. *Zeits. f. Physik,* 61. 11–12. *pp.* 798–804, 1930.

The equilibrium of the thermal dissociation of CsI and of KI vapour into ions has been measured by a method in which the salt is vaporised in an electric furnace, consisting of a vertical graphite tube heated by two different windings, so that the upper part is 100° C. hotter than the lower part, the temperature of which governs the vapour pressure. There is a small hole at the top of the tube through which the ions pass out and enter a brass vessel containing a Faraday cage, which can be charged positively or negatively to 2 volts thus capturing ions with the opposite sign. The object of the experiment was to determine the energy ΔE of the following reaction at absolute zero: $I^-_{gas} \rightarrow I_{gas} + E^-_{gas}$, E^-_{gas} being an electron. It is shown that this value can be obtained from the measurements, by making use of the known values of the heat of dissociation into atoms, and the ionisation voltage of the alkali metal ion. The value obtained is 72·6 ± 2 k.cal., and it is shown that this agrees well with that calculated from Born's lattice theory. H. N. A.

3285. Energy Exchange Within and Between Molecules in Collisions. O. K. Rice. *Zeits. f. phys. Chem.* 7. *Abt. B.* 3. *pp.* 226–233, *April,* 1930.

The reaction velocities of several ethers, and of propionaldehyde, which decompose monomolecularly in the gaseous state, begin to diminish at a higher pressure than one would expect. This implies that the velocity of activation by collisions is not so great as one would anticipate in such complicated molecules. It seems as if the exchange of energy within the molecule is hindered, so that it acts like a smaller molecule; or as if the exchange of energy between the molecules when they collide is relatively small. The fact that hydrogen has almost the same activating power as the organic molecule itself is in favour of the first possibility. Brings forward some theoretical considerations as to the energy exchange, and shows that if the first possibility is correct it is to be expected that the specific reaction velocity at high pressures will be independent of the pressure, diminishing at somewhat smaller pressures, and again becoming constant at still smaller pressures. H. N. A.

3286. Application of Electronic Diffraction to the Problem of Free Rotativity. R. Wierl. *Phys. Zeits.* 31. *pp.* 366–367, *April* 15, 1930.

Under the conditions of this investigation it is concluded that 1 : 2-dichloroethane exists in two molecular species in approximately equal amounts which correspond to a cis- and a trans-compound. The two Cl-Cl distances apart appear to be about 4·4 ± 0·1 Å. and 3·2 ± 0·1 Å. respectively. Free rotation about the C–C single bond which chemical experiment would appear to demand is therefore limited. H. H. Ho.

3287. Photolysis of Aqueous Hydrogen Peroxide Solutions. Parts I and II. A. J. Allmand and D. W. G. Style. *Chem. Soc., J.* *pp.* 596–623, *April*, 1930.

Part I considers experimental methods for an investigation of the relations between degree of decomposition and absorbed light over a wide range of concentration. In the majority of the experiments the active light has been monochromatic or confined to a fairly narrow spectral region. Part II records and discusses the experimental results. Over wide ranges of I, λ, and $[H_2O_2]$, the rate of photolysis is proportional to $I_0^{0\cdot5}$. The velocity at constant incident intensity passes through a maximum as $[H_2O_2]$, is increased and then falls off. A dilute solution of hydrogen peroxide containing inhibitor decomposes with a velocity which rises with increase in concentration at a rate proportional to the square root of the rate of the absorption of energy. The velocity of thermal decomposition of peroxide solutions passes through a maximum and subsequently falls off as $[H_2O_2]$ increases. H. H. Ho.

3288. Photochemical Production of Optically Active Substances. W. Kuhn and E. Knopf. *Zeits. f. phys. Chem.* 7. *Abt. B.* 4. *pp.* 292–310, *April*, 1930.

Assuming that the anisotropy factor (circular dichroism) of the absorption band of an optically active substance is known and that simple photochemical decomposition of the compound by light corresponding to the band is possible, the rotatory power at various stages in the decomposition of the racemate on irradiation with circularly polarised light can be predicted quantitatively. The dimethylamide of azidopropionic acid, $CH_3HCN_3CON(CH_3)_2$ fulfils the required conditions. It is colourless, its optically active forms are stable and are characterised by high rotatory power. It has an absorption band in the ultra-violet with strong circular dichroism. In hexane solution the amide is decomposed by light of the same band, each molecule yielding one molecule of gaseous nitrogen. The decomposition products are inactive, and the unchanged amide can be separated from them by distillation. When decomposition of the inactive amide by circularly polarised light has proceeded to about 40 %, the amide recovered from the solution shows, in a 1 dm. tube, a dextrorotation of 0·78° when right-handed light has been used, and a laevorotation of 1·04° with left-handed light. The order of magnitude and the sign of the effect are in agreement with theoretical considerations. The biological significance of the results is discussed. A. J. M.

3289. Quantum States of Kinetically Activated Molecules. A. Ölander. *Zeits. f. phys. Chem.* 7. *Abt. B.* 4. *pp.* 311–318, *April*, 1930.

In this paper an investigation is described for the numerical identification of kinetically activated molecules in states of excitation by spectroscopic means. It is found that in the gaseous reaction $2HI = H_2 + I_2$, the molecular impacts are associated with three and four oscillation quanta. At a gold surface four quanta are concerned, whereas two suffice with platinum. The selection rule obtained from energy considerations is similar to that found spectroscopically. The reaction $2O_3 = 3O_2$ proceeds between tetra- and penta-quantic molecules. H. H. Ho.

3290. New Silver Voltameter. H. v. Wartenberg and H. Schütza. *Zeits. f. Elektrochem.* 36. *pp.* 254–256, *April*, 1930.

A silver voltameter was designed which was capable of very great accuracy. It was found that by the use of weak acid solutions of borofluoric acid, it was possible to obtain deposits of silver which were bright, and adhered firmly to the kathode. These deposits were not affected by the presence of dissolved air in the electrolyte. The voltameter was capable of being used at current densities up to 1·5 amperes per square dm. By weighing the deposits on a microbalance, very small currents to 10^{-5} ampere could be measured. F. J. B.

3291. E.M.F., Resistance and Capacitance Phenomena in Photovoltaic Cells Containing Grignard Reagents. H. E. Hammond. *Phys. Rev.* 35. *pp.* 998–1107, *April* 15, 1930.

E.m.f., resistance, and polarisation capacitance have been measured in light-sensitive cells containing ether solutions of Grignard reagents in an effort to determine whether the known voltage variations with illumination are due to ionisation changes or to electrode-film variations. Voltage alterations with illumination or X-ray irradiation are described. Resistance variations with illumination are found in ethylmagnesium bromide cells but not in phenylmagnesium bromide cells until a "forming" process has been carried out. Solvation changes seem to offer a more reasonable explanation than ionisation changes. Capacitance changes seem unrelated to resistance or voltage changes. Unsymmetrical resistances are noted in several cases. Capacitances as high as 7 mf. per $cm.^2$ of electrode area have been found. Film thicknesses are estimated to be of approximately molecular dimensions, greater for benzene-ring compounds than for short-chain compounds. Voltage variations are thought to be due to phenomena taking place on or very near electrode surfaces. AUTHOR.

3292. Ammonia-Oxygen Gas Cell. Formation of Nitrates and Nitrites in Presence of Alkalies. C. Marie and C. Haenny. *Comptes Rendus*, 190. *pp.* 967–968, *April* 23, 1930.

By means of the system $O_2 \mid Pt \mid KOH + NaOH$ (fused) $\mid Pt \mid NH_3$

the reactions $NH_3 + KOH + 2O_2 = KNO_3 + 2H_2O$, $Q = 120,000$, and $NH_3 + NaOH + 2O_2 = NaNO_3 + 2H_2O$, $Q = 113,000$, have been realised; on short-circuiting such a pile for a few hours at 250° nitrate and at 350° nitrite can be detected. The temperature coefficient between 200° and 250°C. is $1 \cdot 1 \times 10^{-4}$ volt/°C. The e.m.f. at 243° is 0·665 volt, which agrees well with the thermochemical data. The reaction is much, though only temporarily, retarded if gold replace platinum as kathode. It is accelerated by traces of a metallic oxide (*e.g.*, nickel or copper oxide), an alkaline nitrate or water. On solidification the e.m.f. does not disappear; with a mixture containing 60 % potassium hydroxide it shows on the contrary a rise of 0·2 volt. [See also Abstract 414 (1930).] C. A. S.

3293. Cells with Liquid-Liquid Junctions. E. A. Guggenheim. *Am. Chem. Soc., J.* 52. *pp.* 1315–1337, *April,* 1930.

Cells of the type Hg/HgCl/0·1*N* . HCl/c . KCl/0·1*N* . KCl/HgCl/Hg., where c. was varied from 0·1 to 3·5*N* were investigated. It was found that the diffusion potential between two ideal dilute solutions of different electrolytes or mixtures of electrolytes depended upon the nature of the transition layer between the two end solutions. In the cell given above, as long as the transition layer had a cylindrical symmetry, the e.m.f. obtained never differed by more than a few tenths of 1mV from that given by the " continuous mixture " junction. Irregular fluctuations of several millivolts were obtained when the junction was at the end of a thin tube which dipped into a wider one. F. J. B.

3294. E.M.F. of Zinc Amalgams. J. L. Crenshaw. *J. Phys. Chem.* 34. *pp.* 863–869, *April,* 1930.

Pierce and Eversole claimed that their own measurements of the e.m.f. of zinc amalgams agreed with the earlier determinations of Richards and Forbes, but disagreed with those of the present author [see Abstract 1420 (1928)]. The author compared the measurements of Pierce and Eversole, Richards and Forbes with his own determinations, by a method which gives no undue weight to the most dilute amalgam where the error of measurement is admittedly the highest. When the results were compared in this way they were in excellent agreement. The results of the three investigations were in better agreement with each other than with Hildebrand's equation. F. J. B.

3295. Electrochemical Behaviour and Solution Velocity of Zinc Single Crystals in Sulphuric Acid. M. Straumanis. *Zeits. f. phys. Chem.* 147. *Abt. A.* 3. *pp.* 161–187, *April,* 1930.

The potential values obtained for zinc single crystals, prepared from two different zinc preparations measured against neutral and acid zinc sulphate solutions are given. The solution velocity in acids is measured. It is pointed out that the behaviour of metals in the state of polycrystals is quite distinct from that of the same metals as single crystals. Details of preparation of zinc single crystals are given. It has been found that the different sides of a zinc single crystal behave electrometrically the same in neutral zinc sulphate solution. On acidifying the neutral solutions the potential approaches considerably higher values and shows great fluctuations. On saturation of the electrolytes with hydrogen the potential of zinc decreases and on saturation with oxygen increases. On the assumption that the potential is a function of the solution velocity the observed potential changes are qualitatively considered. It is shown that the dependence of the potential of dissolving zinc is a linear function of the solution velocity. J. K.

3296. Potentiometric Determination of Platinum with Titanium and Stannous Chlorides. E. Müller and W. Stein. *Zeits. f. Elektrochem.* 36. *pp.* 220–234, *April,* 1930.

A potentiometric method for the estimation of platinum was worked out. The titration was carried out in an atmosphere of nitrogen, which was carefully freed from oxygen before use. The estimation was done in HCl solution, and the reduction of the platinum in dilute HCl solution proceeded by stages when the reduction was effected by stannous chloride. The reduction was slow and only progressed as far as the platino stage. Reduction to metal was incomplete. When titanium chloride was used as the reduction agent the estimation was more exact and the reaction progressed appreciably faster. F. J. B.

3297. Current Produced by the Movement of an Electrode in Electrolytes. M. O. Charmandarjan and B. J. Perwuschin. *Zeits. f. Elektrochem.* 36. *pp.* 248–252, *April,* 1930.

The movement of a platinum electrode in an electrolyte produced an electric current in a closed circuit. The moving electrode formed the negative pole. In acid solutions the current strength depended upon the acid used and increased when the solution had been electrolysed. In hydrochloric acid the moving electrode was positive. When the electrode was charged with oxygen or chlorine movement produced no current. Impurities on the electrode, treatment with chromic acid and alcohol greatly reduced the phenomenon. After ignition of the electrode it returned in a short time. F. J. B.

3298. Conductance of Strong Binary Salts in Solvents of Very Low Dielectric Constant. The Nernst-Thomson Rule. P. Walden. *Zeits. f. phys. Chem.* 147. *Abt. A.* 1–2. *pp.* 1–37, *April,* 1930.

The electrolytes used in the continued experiments [see Abstract 1678 (1930)] are $AgClO_4$ (which, dissolved in water or alcohol, behaves like a true salt, and in benzene and toluene like a pseudo-salt of Hantzsch), tetra-amylammonium iodide and other salts of the latter type. In solvents of very low dielectric constant ϵ (benzene 2·17, toluene 2·2, trichloroethylene 3·42, chloroform 4·95), which are hydrocarbons free of oxygen and generally regarded as non-ionising, the equivalent conductance λ_v increases with rising temperature, as in ionising media; but with increasing volume (dilution) the λ_v diminishes to a minimum. For the descending branch of the λ/v curve the product λv is constant, and $v_{min.} = (K/\epsilon)^3$, where K has the value 30 to 35. In ethyl ether ($\epsilon = 4\cdot 35$) and chloroform $\alpha = \lambda_v/\lambda_\infty$ holds practically for high dilutions. The Nernst-Thomson rule, that the greater the ϵ of the solvent the greater the electrolytic dissociation (and the greater also the weakening effect on the electrostatic attraction between the ions), is found, by applying the Kohlrausch relation $\lambda_\infty = \lambda_v + a\sqrt{c}$ for extrapolation, and holds for the electrolytes mentioned and other typical binary salts, also for a large number of other organic solvents of large ϵ alcohols, acetone, pyridin, also ammonia and water. For all these a_v has, at high dissociation, the same value 0·976 at $t = 25°$, and $\epsilon\sqrt[3]{v} = \text{const.}$ The author finally calculates conversely the α from the dilution volumes v, the ϵ and the product $\lambda_\infty . \eta$ by the empirical formula of his own and Onsager's formula and compares the resulting α values. H. B.

3299. Variation of the Electrokinetic Potential Origin. G. Ettisch and A. Zwanzig. *Zeits. f. phys. Chem.* 147. *Abt. A.* 1–2. *pp.* 151–154, *April*, 1930.

Previous treatment of the electrokinetic potential origin, both from theoretical and experimental standpoints, have treated it as an independent variable in a function. In the presence of molecules which are surface active in addition to the electrolyte, measurements of the potential of flowing have shown that the potential is a function of the velocity of flow, that is, of the driving force. The consequences of this fact lead to a variety of conclusions. F. J. B.

3300. Electrochemical Investigation of the System $AlBr_3$-KBr in Ethylene Bromide. W. A. Plotnikow and W. A. Kikez. *Zeits. f. phys. Chem.* 147. *Abt. A.* 3. *pp.* 215–226, *April*, 1930.

The system $AlBr_3$–KBr in ethylene bromide was found to have a definite conductivity. The specific conductivity of a solution containing 7·3 % KBr, 39 % $AlBr_3$ and 53·7 % $C_2H_4Br_2$ was $4 \cdot 63 \times 10^{-3}$. Cryoscopic determinations of the system $AlBr_3$–$C_2H_4Br_2$ showed that half the number of $AlBr_3$ became Al_2Br_6. Further, when KBr was added to the system a rise of freezing point was obtained, pointing to the formation of polymeric complexes of the $AlBr_3$, such as Al_2Br_6nKBr. When the solution was electrolysed ethylene was obtained at the kathode and bromine at the anode. The decomposition potential was found to be 0·64 V, which was in approximate agreement with the thermochemical data of Berthelot. It was considered probable that the complexes were dissociated into ions to a very large extent. F. J. B.

3301. Electrochemical Investigation of the System $AlBr_3$-KBr in Toluene and Xylene. W. A. Plotnikow and S. Jakubson. *Zeits. f. phys. Chem.* 147. *Abt. A.* 3. *pp.* 227–230, *April*, 1930.

The system $AlBr_3$–KBr in solution in toluene showed a conductivity of $4 \cdot 22 \times 10^{-3}$ for a solution which contained 41·94 % $AlBr_3$ – 6·54 % KBr. The conductivity increased with increase of concentration of the KBr. Electrolysis of solutions of $AlBr_3$–KBr in toluene and in ortho- and para- and commercial xylene resulted in solution of aluminium at the anode and the deposition of aluminium at the kathode. Electrolysis with silver and copper electrodes resulted in the solution of silver and copper in accordance with Faraday's law. The copper was assumed to be in the cuprous state in solution. The decomposition potential of the toluene solutions was 2·05 and in the para-xylene solution 1·65 volts. Thomson's formula leads to 1·78 V as the decomposition potential. F. J. B.

3302. Preparation of Thallium by Electrolysis of its Oxides. L. Andrieux. *Comptes Rendus*, 190. *pp.* 925–927, *April* 14, 1930.

Dissolves brown hydrated peroxide at about 900° C. in boric anhydride, or in one of the borates; the peroxide changes to thallous oxide, losing its water and part of its oxygen, and the melt can be electrolysed, using a carbon crucible as kathode and a central carbon rod as anode. The best results are obtained with the alkaline borates $K_2B_4O_7$ and $Na_2B_4O_7$, either alone or mixed with alkaline fluorides (*e.g.*, NaF), the baths are more fluid, the voltage less and the yield greater than when B_2O_3 is used. Borates and fluorides of the alkaline earth metals are also less satisfactory.

H. N. A.